PAINT and VARNISH Production

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NEXT ISSUE

The June issue will carry an article on Rotary Pumps for the Paint and Varnish Industry. The author discusses factors which affect the life of rotary pumps; maintenance and care of rotary pumps; operation of pumps in high temperature application; and problems to be considered in the installation of these pumps.

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Editorial Comment

Air Pollution

AT THE recent conference of the air pollution abatement committee of the Manufacturing Chemists Association, it was pointed out that industry should assume the leadership in solving community-wide air pollution problems. Industry was urged to raise its own standards of housekeeping to eliminate pollution evils.

Studies have shown that air pollution or smog cannot be cured solely by the enactment of a law or prohibition. In view of this situation, the conference recommended that the first step in the elimination of objectionable fumes or smog should be the services of competent and unbiased engineers and scientists to determine the causes and sources of air pollution.

In line with the above recommendations, it is interesting to note that the paint industry has already taken steps to investigate fume control problems encountered in the manufacture of coating materials. This investigation was undertaken by a joint committee of the Chicago Paint, Varnish and Lacquer Association and the Chicago Paint and Varnish Production Club, Alfred P. Stresen-Reuter, chairman. Some 18 months were spent in making surveys as to the causes of fumes in the paint industry and also testing various types of fume control equipment.

The committee concluded that the chief complaint against the paint industry was the emission of obnoxious fumes in varnish and resin cooking operations. It was therefore decided that all available equipment offered by manufacturers of fume control apparatus for the paint industry should be field tested. Laboratory results on such equipment did not produce anything concrete. It was found that such results were not indicative of actual plant operation. The committee concluded that all fume control equipment should be field tested in a production manner before acceptance by any interested party.

During the course of the investigation, it was discovered that in the elimination of obnoxious fumes, there were other factors besides control equipment which must be considered.

Firstly, there is no fume control problem with closed kettle operations. Open kettles, or movable kettles with no covers presents the fume problem. Thus, the committee recommends that cooks involving fume problems be cooked in closed-type equipment, if possible.

Secondly, it has been found that certain raw materials used in the formulation of vehicles have obnoxious odors, whereas similar materials from other sources do not. It is therefore essential that formulators begin to recognize this problem and investigate the possibility of utilizing materials of a less obnoxious odors.

Thirdly, a rigid maintenance program is advisable in keeping fume control equipment operating at maximum efficiency. Outside inspection should be made several times a day as a means of determining whether such equipment is operating properly or not.

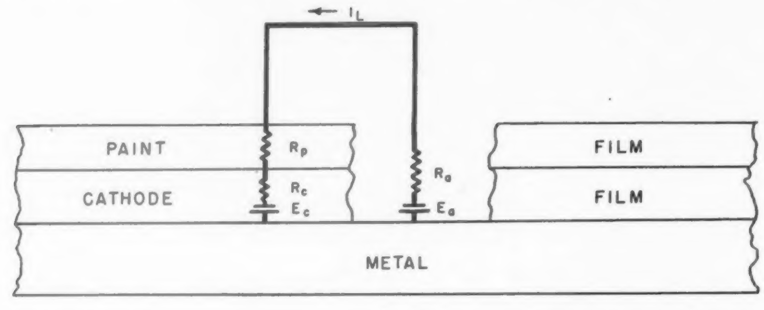
The committee is of the opinion that the only answer to a complete elimination of fumes is by incineration. However, the problem of safety and cost have caused the committee to look unfavorably upon this method. Further checks on incinerators are now being made and this will be available to interested members.

It is obvious that from a technical standpoint, findings of this committee have been very helpful to the paint industry. However, the committee was quick to recognize the importance of industrial relationships, education and legal aspects connected with the problem of fume control, and advises that manufacturers can obtain amicable relationships with surrounding neighbors by recognizing that a fume problem does exist and taking steps to eliminate it. Ignoring complaints of neighbors simply aggravates the situation.

Undoubtedly there are many questions yet to be answered, but the basic facts have been brought to light. We recommend that those who have fume control problems obtain a copy of the findings of this committee and put them to use. The answer to your problem may be right in that report.

FREE CORROSION

$$(1)\ E_a - E_c - i_L(R_a + R_c + R_p) = 0 \qquad (1a)\ i_L = \frac{E_a - E_c}{R_a + R_c + R_p}$$



E_a — Anode potential
E_c — Cathode potential
R_a — Anode film resistance
R_c — Cathode film resistance
R_p — Paint film resistance
i_L — Free corrosion current

Figure 1. Coating resistances in the freely corroding metal-paint systems.

The Use of Cathodic Protection with Conventional Paint Systems

By L. P. SUDRABIN
Electro Rust-Proofing Corp.

MOST of the steel structures submerged in water to which cathodic protection is being applied have been coated at some time with one of the underwater paints such as linseed oil, phenolic, vinyl, coal tar enamel, asphalt types, etc. Although nearly all these coatings materially assist cathodic protection in providing complete corrosion control, they have shown a susceptibility to degradation by electrolytic effects.

Cathodic protection has been applied to many thousand steel structures submerged in water. This method of corrosion control requires that sufficient current be drained to an auxiliary anode so that no electrical current flows into the water at any point on the submerged structure. The author[1] has previously discussed this application to water tanks, clarifier mechanisms, deep well pumps, etc. Mears and Brown[2] and others have established the fundamental nature of cathodic protection in electrolytes.

It is the intent of the following discussion to establish some of the factors to be considered in the electrolytic degradation of the paint films which are now in common use and to encourage further development of underwater coatings to be used in combination with controlled cathodic protection.

Those concerned with the protection of the extensive underground steel pipe transmission and distribution lines have established a procedure using coatings and a reinforcing wrapper which, with a minimum of properly applied cathodic protection, assures complete corrosion control of buried steel pipe against soil attack. This overall system has proven to be good economically over long periods of time in protecting a steel structure upon which intense corrosion forces are exerted and which is not readily available for examination and repair. Similarly, steel structures such as sprinkler and water storage tanks, clarifiers, dock piling, deep well pumps in contact with water are not easily made available for examination and repair.

For example, in the northern United States the formation of ice causes severe scoring of the paint film on the submerged surfaces. Since the most intense corrosion activity occurs here during the hot summer months, to attain satisfactory corrosion control it is either necessary to drain the tank and to at least patch the paint or else to apply cathodic protection to prevent attack on the bare metal areas as soon as the ice is out of the tank. The latter policing step is easily applied without draining and losing the availability of the tank.

Fundamentals

ASIDE from the inhibitive effects of some pigments compounded in paints, the main property of these films is their high electrical resistiv-

This paper was presented at the Third Symposium of Paint and Varnish Chemistry sponsored by the College of Engineering of New York University held on Nov. 18, 1950.

ity. The significance of the paint film resistance in reducing corrosion and the amount of cathodic protection current required to assure complete corrosion control can be established by the use of the electrochemical principles of corrosion and cathodic protection.

To visualize an instance of electrochemical corrosion let us assume a coating on a metal surface with a scribed scratch line exposing a small area of bare metal or else a pin hole flaw in the coating. It is usually observed that an anodic process (solution of iron) occurs on the exposed metal area and, as will be later shown, a cathodic process often exemplified by blistering, alkali accumulation, hydrogen evolution, etc. occurs. The relation of film and coating resistances in the freely corroding metal-paint system are shown in Figure 1. By use of Kirchoff's law, the following relationship is obtained:

(1) $E_a - E_c - i_L\ (R_a + R_c + R_p) = 0$

(1a) $i_L = \dfrac{E_a - E_c}{R_a + R_c + R_p}$

It can be seen that the use of a paint film having a high resistance (R_p) can greatly limit the value of the corrosion current (i_L). Similar treatment of the cathodically protected specimen Figure 2 will show that the protective current (i_x) required to limit the anode corrosion current $i_a = 0$ is also markedly reduced by a high resistance (R_p) paint film.

(2) $E_a - E_c - i_a\ R_a - i_c \times (R_c + R_p) = 0$

(2a) $i_a + i_x = i_c$

(3) $E_a - E_c - i_a\ R_a - i_a \times (R_c + R_p) - i_x\ (R_c + R_p) = 0$

(4) $E_a - E_c - i_x\ (R_c + R_p) = 0$
Corrosion ceases when $i_a = 0$

(5) $i_x = \dfrac{E_a - E_c}{R_c + R_p}$

In addition to considering the influence of the paint film resistance, a much more vigorous treatment would be needed to illustrate the effect of paint films upon cathodic polarization. In a general sense, it is recognized that as the paint film deteriorates its resistance decreases, thereby allowing current to pass more readily through it. This results in the accumulation of cathodic product causing a back E.M.F. as distinguished from the IR drop[3]

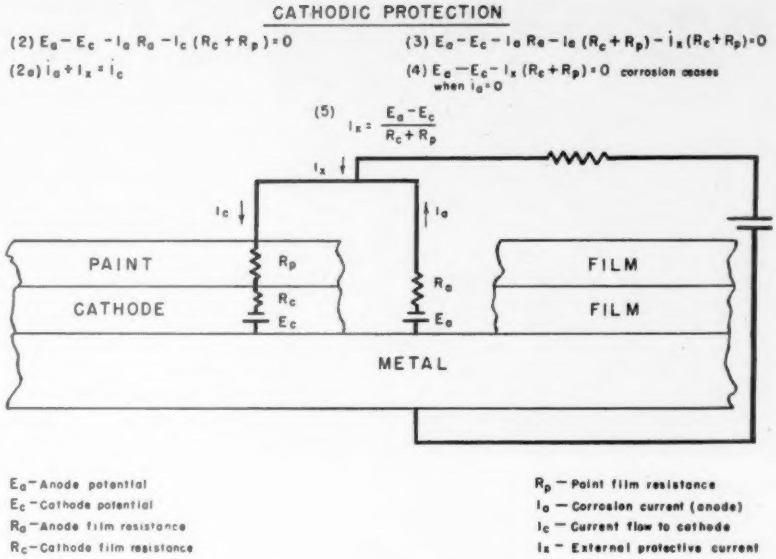


Figure 2. Cathodically protected specimens.

usually included in overall polarization measurements. This chemical polarization on the cathodic areas reduces the net potential differences over the metal surface, thus reducing the flow of corrosion current.

The presence of any inert matter more or less uniformly covering the cathodic areas will function to retard the diffusion outwards of the cathodic products such as alkali, hydrogen, etc. and oppose the diffusion of depolarizing agents such as oxygen molecules inwards from the bulk of the water. The more effective the diffusion barrier on the cathodic areas, the less the cathodic protection current required to maintain the polarization. A paint film classified in poor condition by itself can materially reduce the current requirements for complete corrosion control by cathodic protection when compared with the requirements for protecting a clean metal surface. The uniform accumulation of sand, slime, rust, or the deposition of scale-forming salts from water on the cathodic areas of submerged metal have also been observed reducing the protective current requirements by their influence on chemical polarization.

Although many coatings, particularly vinyl-type paints and heavy coal tar enamels, function well when used on submerged surfaces in combination with cathodic protection, the best overall results are attained when the cathodic protection is carefully controlled.

The control should be such that the potential measured at the paint film is close to the open circuit potential of an iron anode. A potential much in excess of −.73 to .78 volts measured against a Sat. KCL calomel half cell will tend to accelerate blistering and destroy the paint film, whereas a lower potential may provide only partial protection at the flaws in the paint coating.

In many instances the potential gradient developed across a paint film by galvanic anodes will strip paint films. Thus, it is important that the cathodic protection be controlled whatever the source of protective current.

The use of controlled cathodic protection with suitable paint films on submerged steel surfaces permits realization of a completely effective corrosion control system.

Electrochemical Forces

HAVING noted the properties of paint films upon cathodic protection current requirements, it is necessary to consider the significance of the electrochemical forces and reactions upon the metal-paint system.

On the cathodically protected areas receiving current, a reducing process electrochemically equivalent to the current flow will occur. Typical cathodic processes are:

(1) $2H + 2e \rightarrow 2H^{\circ} \rightarrow H2$
Reduction of hydrogen ions

(2) $O_2 + 2H\ \ 2O + 4e \rightarrow 4OH-$
Reduction of molecular oxygen

(3) $Fe^{+++} + e \rightarrow Fe^{++}$
Reduction of metal ions

Fig. 3. Alnico magnet used with KCl calomel half cell.

Each of the above processes is accompanied by an increase in hydrogen ion concentration. These reactions suggest that we must consider the effect of hydrogen gas evolution, alkali accumulation, metal pigment reduction, etc. in any paint system used in conjunction with cathodic protection.

It has also been observed that water is transported through a paint coating under the influence of an electrical potential gradient. This process of electroendosmosis has been demonstrated by *Kittelberger* and *Elm.*[4] They obtain a potential gradient by coupling a bare steel panel (anode) to a painted steel panel. In a series of panel tests using linseed oil paints with four different pigments, they noted that the panels blistered badly in a few days in spite of the limited potential gradient development by the couple used. They further observed over 90% of water absorption in a linseed oil type paint coating was caused by the potential gradient.

An example of the accumulation of hydroxyl ions and water between the paint and base metal occurred in one of the first elevated tanks to which cathodic protection was applied. An overall protective current density of 0.3 ma per square foot applied to the submerged area painted with three coats of red lead linseed oil caused severe blistering in less than one year. In spite of the poor condition of the paint, this low current density was providing complete corrosion control ten years later. In Table 1, the analysis of the water behind an intact paint blister is compared to that of the bulk of the water. Analysis of a deposit formed by interaction of the scale-forming salts in the water and the highly alkaline cathodic solution oozing out of a ruptured blister is also shown.

Field Observations

In several of the earlier applications of cathodic protection to newly painted tanks, severe blistering and peeling of the paint was observed in a very short time. The initial current applied had been established by the needs for a corroding system in which the paint had lost much of its resistance. It became evident that some means of current regulation must be used to derive the best overall corrosion control.

Limiting the current flow to a newly painted surface initially and gradually increasing the current flow as the need is established by visual examination on subsequent inspections has been a fairly satisfactory practice. However, it is now felt that the best control is to limit the protective current flow so that the potential measured at the paint surface is not more electronegative than that of the open circuit potential of an active iron anode. This potential probably ranges between −.73 and −.78 volts when measured against a sat. KCl calomel reference electrode. This control would not provide a potential gradient across the paint film appreciably greater than that established by the bare metal-paint panel couple. Under this potential regulation, complete corrosion control would be assured without accelerating the breakdown of the paint film more rapidly than if an area of the painted tank were left bare.

The potential profile of a submerged structure such as an elevated water storage tank can be readily determined by lowering a standard reference electrode to the base of the riser and measuring the potential at intervals with a suitable H. R. voltmeter or potentiometer as the electrode is raised along the submerged metal surface. To provide the proper positioning of the electrode tip so as to minimize IR drops through the

TABLE 1

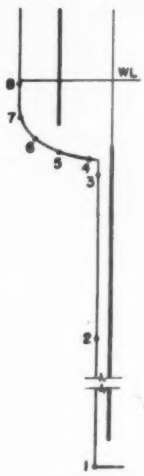
	Deep well water in tank	Solution under paint blister	Deposit Analysis	
Ca	80 p.p.m.		SiO_2	20%
Mg	34 p.p.m.		CaO	46.5 %
P.P. Alk.	0 p.p.m.	1158 p.p.m.	Mg O	11.2 %
M.D. Alk.	301 p.p.m.	3910 p.p.m.	R_2O_3	.2 %
T.S. Evap.	389 p.p.m.		ign. loss	41.6 %
Total Hardness	342 p.p.m.		SO_3	trace
Dissolved 02	1.01 c.c./liter at surface .50 c.c./liter at bottom of bowl .084 c.c./liter in riser		Cl	trace
pH	7.4	10.3		

POTENTIAL PROFILE

NO. 6471 100,000 GALLON HEMI-ELIP BOWL 28'8"DIA.-23' HT. RISER 4' DIA.-60' HT. 9-13-50

PAINT SYSTEM - 2 COATS R.L. PHENOLIC 9-49

CATHODIC PROTECTION	PROT. CURRENT	AREA
BOWL	.65 AMPS.	2700 SQ. FT.
RISER	1.3 AMPS.	750 SQ. FT.



LOCATION		POT VS SAT. KCl CALOMEL
1		-.485 VOLT
2		-.780 "
3		-.920 "
4		-1.240 "
5	BET. ANODES	-1.125 "
	BEL. ANODE	-1.205 "
6	BET ANODES	-1.020 "
	OPP. ANODE	-1.030 "
7	BET. ANODES	-.705 "
	OPP. ANODE	-.800 "
8	BET. ANODES	-.685 "
	OPP. ANODE	-.768 "

NOTE - PAINT SCARRED BY ICE, SOME BLISTERING, SEDIMENT ON FLOOR INCLUDING ACTIVATED CARBON. NO CORROSION ACTIVITY NOTED.

Figure 4. Potential profile as observed before cathodic protection was applied to a newly painted elevated tank.

water, the writer uses a sat. KCl calomel half cell with a permanent Alnico magnet (Fig. 3).

Figures 4 and 5 show some of the typical potential profiles observed. In Fig. 4 are the potentials noted before cathodic protection was applied to a newly painted 2,000,000 gallon elevated tank in Texas. An overall current density of slightly over 0.1 ma per square foot was adequate to assure complete corrosion control. A current density in excess of 10 ma per square foot would probably have been required to prevent any initial attack on a bare steel surface in the water environment encountered.

In Fig. 5 are the potentials observed in an elevated water storage tank one year after it had been painted and cathodic protection had been applied. This tank has ice formation which damages the coating. Inspection of some of the exposed areas of metal showed they were not corroding. Electrodes were reinstalled in this tank as soon as the ice had melted in the spring. An overall current density of 0.25 ma per square foot was sufficient to protect the tank bowl whereas a somewhat higher current density is required to protect the riser. It is felt that the high potentials measured on the floor area of this tank were due to the thin layer of silt and activated carbon accumulating over the period of a year. This thin layer functioned as an effective diffusion barrier layer leading to sizeable polarization.

Some observations have been made on the protective current requirements needed to polarize the metal exposed at a few pinhole flaws in 15,000 gallon steel tanks painted with several coats of chlorinated rubber so as to prevent staining. An overall current density less than 0.01 ma per square foot proved adequate to polarize the metal at the exposed areas.

To illustrate the importance of potential control, the coating on a newly coated brine storage tank was severely blistered and ruptered in less than one month by four magnesium anodes coupled to the structure. In this instance, the full poten-

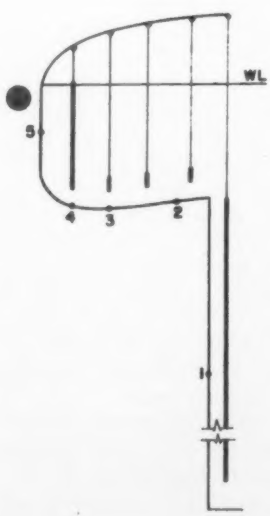
(Turn to page 27)

POTENTIAL PROFILE

NO. 6469 2,000,000 GALLON RAD. CONE BOWL 102' DIA.-35' HT. RISER 10' DIA.-117' HT. 5-9-50

PAINT SYSTEM (SAND BLASTED IN SHOP) 1 SHOP COAT R.L. (LINS. OIL)
1 PATCH COAT R.L. (LINS. OIL) 1950
1 FIELD COAT R.L. (LINS. OIL) 1950

CATHODIC PROTECTION	PROT. CURRENT	AREA
BOWL	2.11 AMPS	17,400 SQ. FT.
RISER	.545 AMPS.	3,600 SQ. FT.



		POT VS SAT KCl CALOMEL	
LOCATION		UNPROT	PROT. APPLIED
1		-.433 VOLTS	-.635 VOLTS
2		-.471 "	-.754 "
3	BEL. ANODE	-.431 "	-.820 "
	BET. ANODES	-.426 "	-.773 "
4	BET. ANODES	-.430 "	-.859 "
5	OPP. ANODE	-.368 "	-.820 "
	BET. ANODES	-.400 "	-.831 "

NOTE - PAINT NEW

Fig. 5. Potential profile as observed in an elevated water tank one year after being painted and cathodic protection had been applied.

Protective Coatings Research

BY U.S. ARMY ORDNANCE CORPS

IN 1942 the then Ordnance Department was designated as custodian of Class 3 U. S. Army Specifications for paints and related materials. At this time, due to the need of "all-out" production of all classes of required material, it was necessary to make rapid development and expand facilities to produce material without too much consideration for cost and inconvenience to manufacturers. With the increased demand for many classes of material a need for standardization soon became apparent.

Completed Research

Color—In the early period of production, color was of secondary importance. There was a multiplicity of colors and shades by various War Department agencies due to the fact that the Standard Color Card adopted about 1920 covered only 24 gloss colors. It soon became apparent that lusterless and semi-gloss finishes generally were more desirable for military equipment. To meet the demand for such finishes on many classes of materials, the various Supply Services, acting independently, adopted colors which were similar but differed in shade sufficiently to cause difficulty in production. Simplicity and standardization of colors were necessary to correct the confusion and eliminate production difficulties.

In October 1942, the Ordnance Department undertook an extensive program to standardize all colors used by War Department agencies. It was found that a total of more than 175 colors (gloss, semi-gloss, and lusterless) were in use. Through informal cooperation of all interested agencies, samples of color chips in current use were assembled and compared. Approximately 100 were eliminated and the 72 agreed upon colors were adopted as standard. When all of the colors were prepared, a spectrophotometer was used for measuring and recording the exact color. The curves produced by this method are kept on file and consequently at any future date, any color may be matched to the original regardless of the age of the existing color chip which is subject to fading or darkening with age.

Plating and Rustproofing—Previous to 1942 there had been no attempt to specify a high quality protective finish such as electroplating. With the advent of the war it soon became apparent that individual requirements for each type of rustproofing were necessary. The first attempt to accomplish this resulted in the revision of U. S. Army Specification No. 57-0-2 covering three types of rustproofing; namely, (1) plating, (2) phosphate coatings, and (3) oxide black and miscellaneous. Under this system it was possible to specify a particular type of finish desired. However, it was noted that individual requirements for particular items of material were falling far short of current needs.

To fill these needs, an intense research program was started in which Frankfort Arsenal, Springfield Armory, Rock Island Arsenal, the National Bureau of Standards and the American Society of Testing Materials cooperated. In order to meet all conditions of service, tolerances, etc., it was necessary to make exhaustive tests to determine the various limits that should be established with zinc, cadmium, nickel, chromium, and lead plating. In all, it was decided that each type of plating should be specified in at least three different thicknesses with zinc and cadmium having a supplementary chromic acid finish that prolongs the life of the finish, and with lead and chromium finishes having the choice of using or not using a preliminary copper coating.

Innumerable phosphate finishes were being used before the existence of U. S. Army Specification No. 57-0-2C. It was found that four different types of phosphate coatings would adequately cover the needs of the Ordnance Department in all cases. These were: (1) phosphate coatings finished with non-drying petroleum oils containing corrosion inhibitors suitable for use on sliding or bearing surfaces, (2) the same finish as (1) except that dimensional tolerances were set up permitting the use of phosphate coatings which heretofore had been impossible to use as a rustproofing finish, (3) phosphate coatings finished with a rust preventative suitably reduced for application and containing corrosion inhibitors, (4) phosphate coatings suitable for finishing with paint products.

Included in this specification were oxide black coatings which were previously specified solely by trade name. In order to cover all needs, the oxide black coatings were set up in three classes and three grades as follows:

Class A. Alkali oxidizing processes.

- Grade 1. Oxide Coatings finished with non-drying petroleum oils.
- Grade 2. Oxide Coatings finished with rust inhibiting lacquer.
- Grade 3. Oxide Coatings finished with synthetic resin coatings.

Class B. Chromate.

Class C. Fused Salts.

Enamel, Rust Inhibiting, One Coat—Due to the large increase in production of small arms ammunition during 1941 and 1942, it was necessary to produce the containers with emphasis on quantity rather than quality. Consequently, after fabrication of the metal box, the corrosion resistant finish was given little, if any, attention other than to pro-

vide a lusterless olive drab coating for camouflage purposes. It soon became apparent that this camouflage coating provided little if any protection against atmospheric corrosion. Consequently many failures of the ammunition containers in the boxes were reported. A paint finish that could satisfactorily withstand the corrosive environment encountered overseas was needed.

A one-coat system which had successfully been used by the Engineers for painting landing mats was tried and proved equal to a primer and semi-gloss top coat system. However, the material was hard to apply and in many cases did not meet the requirements of Ordnance. An extensive research program was immediately started with the result that a minimum of other characteristics were changed and the pigmentation of the enamel remained the same. The paint was covered by the issuance of U. S. Army Specification No. 3-181. This finish proved to be remarkedly effective and resulted in no delay in procurement or lack of protection of the containers.

Phthalic Anhydride—Almost at the outset of the war it became apparent that phthalic anhydride used by manufacturers of alkyd resins would not be produced in sufficient quantity for the Armed Forces. Therefore, methods of conserving phthalic anhydride was necessary on nearly all specifications.

Early in 1942 the Ordnance Department issued a series of specification AXS-750, AXS-751, AXS-752, AXS-753, AXS-754 which permitted the use of a full alkyd or modified semi-alkyd enamel. Scarcely six months after the issuance of these specifications the use of dibutyl phthalate in the manufacture of insecticides greatly reduced the amount of phthalic anhydride for use in alkyd resins. However, the alternate specifications were available.

Cleaning—One of the major problems in finishing equipment for the U. S. Army was adequate cleaning prior to painting. In most cases, the paint failure was assumed to be a failure of the paint whereas the blame actually was in the surface preparation.

Exhaustive tests by the Ammunition Division in the various ammunition plants conclusively proved that the vast majority of all paint failures was due to improper cleaning of the metal. Numerous attempts were made to accumulate data that would provide the basis for a specification that would permit the Inspection Section to reject improperly cleaned material. The problem was solved with the issuance of the Ordnance Department Tentative Specification AXS-1245.

Marking Obliterating Lacquer—Throughout the war at many of the ports of embarkation both at home and abroad, it was found that innumerable packing cases could have been reused providing there was some way of remarking and restencilling with a minimum of delay.

The problem of obtaining a paint with the desirable characteristics of obliterating old marking and permitting restencilling within a few minutes was faced in 1943. Four months of intensive research provided a neutral colored lacquer that had the desirable characteristics of obliterating old markings without lifting the paint and was capable of being stencilled within 20 minutes. Large quantities of this lacquer have since been purchased under U. S. Army Spec. No. 3-199.

Primer, Zinc Yellow—The war resulted in a great increase in the use of aluminum and magnesium alloys. In the beginning the ordinary paint systems were used in the finishing of these alloys. Service reports showed that a primer of the type covered by AN-TT-P-656, a quick-drying zinc chromate pigment primer, was giving superior results on the alloys used in the aircraft industry. Tests were initiated to find a primer of the zinc chromate type that would be suitable for Ordnance material.

Many different formulations were suggested and tried. The one that gave satisfactory results happened to be a combination of three existing types (Army-Navy, Navy Bureau of Ships, and Maritime). This particular product has proven to be of great value in increasing the durability of these alloys and is being procured under U. S. Army Spec. No. 3-201.

Present Projects

General problems on Organic Protective Coatings include:

1. New methods of chemical analysis have been developed for fungicides (pentachlorophenol), salicylanilide and phenyl mercuriocoleate.
2. Since many industrial unions will not permit the spraying of paints containing lead, work was started to develop an improved lead free automotive primer. Approximately 100 different primers were prepared and are now on exposure at Aberdeen Proving Grounds, White Sands Proving Ground, Churchill, Canada, and Panama. These have been exposed for over two years.
3. Test panels to determine optimum film thickness of Ordnance paints have been exposed. Exposure time has been insufficient to provide any durability data.
4. In order to obtain a lacquer finishing system for automotive use, a primer, surfacer and top coat of superior quality have been developed.
5. Specific methods of chemical analysis for red lead, lead chromate and zinc oxide in combination have been developed. No exact method of analysis for this combination of pigments has been previously available.
6. Work is progressing on the development of a satisfactory quick-drying one coat enamel. The drying time of the material currently being used is not considered satisfactory. Three new materials have been tested that appear to be satisfactory.
7. Specific methods of chemical analysis for dibasic acids in alkyd resins have been developed. These methods have an accuracy of better than plus or minus 0.5%. Previous methods were accurate to only plus or minus 2%.
8. An investigation has been started to determine the cause of fading of lusterless olive drab paints. Panels have been prepared and are on outdoor exposure.

It is planned to investigate new materials for Ordnance applications, develop new coatings as may be necessary, improve existing materials and/or coatings and develop new methods of testing as necessary.

Salts Spray Tests—Failure of painted steel panels is more rapid in 5% than 20% salt spray with earlier and more pronounced blistering and rusting. These results correlate with the more rapid rusting of steel, the greater water adsorption of paint films and the higher rate of water vapor transmission of a paint film in a 5% salt spray.

Salt spray specifications permit a wide range in the amount of fog falling on a given test area. Non-uniform results have been obtained on a wide variety of paint films over the permissable rate of fog. Exposure tests with the 5% salt spray have been completed and further tests are being made on 20% salt spray.

Representative paints have been exposed to a 5% salt spray and 100% relative humidity test. The salt spray test has generally been found to be more severe and better adapted to testing of Ordnance types of paints.

Tests will be continued in comparing 5% and 20% salt spray and in the improvement of salt spray testing. Comparison tests between humidity and salt spray testing will be continued.

Protective Finishes and Treatments for Metals—Performance limits are being obtained on surface coatings of magnesium.

Tests are being made to find a method for determining the completeness of sealing of anodic coatings.

Various buffering and accelerating agents and processes such as room temperature phosphating are being investigated.

The coefficients of friction of various phosphate coatings are being determined. The data indicates that contrary to common belief, the coefficient of friction of zinc phosphate coatings is lower than manganese base coatings.

It is planned to continue work on determining performance limits of various surface treatments and to continue evaluation and development of phosphate coatings.

Cleaning and Pickling

1. A satisfactory two bath cleaner has been developed for removing carbon and lead deposits on machine gun boosters. Work is continuing to develop a satisfactory one bath cleaner.

2. A new radiator cleaning compound has been developed. This cleaner is much more effective in removing rust and lime deposits than the cleaner currently in the supply system. Specification requirements are being determined.

3. A low pH alkaline cleaner and paint stripper has been developed This material is almost as effective at a low pH as are the strongly caustic solutions that are hazardous to handle.

4. A self-emulsifying grease cleaning compound has been developed that appears to be far superior to material currently being used. Specifications requirements are being developed.

5. A vapor cleaning compound with increased efficiency has been developed and specification requirements have been set up.

It is planned to continue development work on cleaning materials, evaluating new compounds, etc.

In an effort to obtain faster rust removal than possible with phosphoric acid other acids were investigated. Work was centered on hydrochloric acid as it was determined sulfuric acid was not a feasible material to be used in base shops. Many commercial inhibitors were investigated, but all acids tended to embrittle the metal. A new inhibitor was developed that, based on tests to date, appears to produce a minimum of hydrogen embrittlement.

It is planned to continue hydrogen embrittlement tests on various types of steel. Also development work is progressing on an inhibitor that will be more stable in concentrated hydrochloric acid.

Maintenance Materials

1. A compound for protecting the underside of vehicles has been developed and a specification issued.

2. A strippable film for masking prior to painting is being investigated.

3. Various rust-arresting compounds have been investigated and a specification prepared. This material is for use in preventing further rusting of equipment until proper maintenance can be given. Various maintenance materials will be investigated as the need arises.

Strippable Films

1. Preliminary tests have started on an investigation of the correlation between performance characteristics and chemical composition of JAN-C-149 materials. Panels of hot dip compounds have been prepared and are being exposed in sea water and on atmospheric exposures at Aberdeen Proving Grounds, White Sands, N. Mex., Ft. Churchill, Canada, and Panama. Type I coating fails to give protection after 180 days at APG. No results are available from the other locations at this time. At the same length of time, Type II coatings were still giving good protection.

2. Several different strings for use in dipping parts in the hot dip compound have been tested. Aluminum foil, copper, steel and aluminum wire are now being tested and the results will be correlated with those of the strings.

3. Tests are continuing on products submitted for qualification for Types I and II of JAN-C-149.

4. Tests have been completed on a new type webbing compound under AXS-1756. This material can be used as it is packaged, presenting an advantage over the present webbing compound that has to be mixed with the coating compound before use. Tests are continuing on products submitted for qualification under AXS-1756.

5. As a means of simplifying procedures in the use of strippable dipping compounds, an attempt is being made to develop a room temperature dipping compound. No satisfactory material has been found at this date although the use of cellulose acetate butyrate gelatin type lacquers appears promising.

Work on the development of a combination webbing and plastic sprayable strippable film will be continued. The development of new tests and compounds that will give better protection and easier stripping of hot dip compounds is being continued. It is anticipated that a satisfactory room temperature dipping compound having all the characteristics of the hot dipping compounds will be developed.

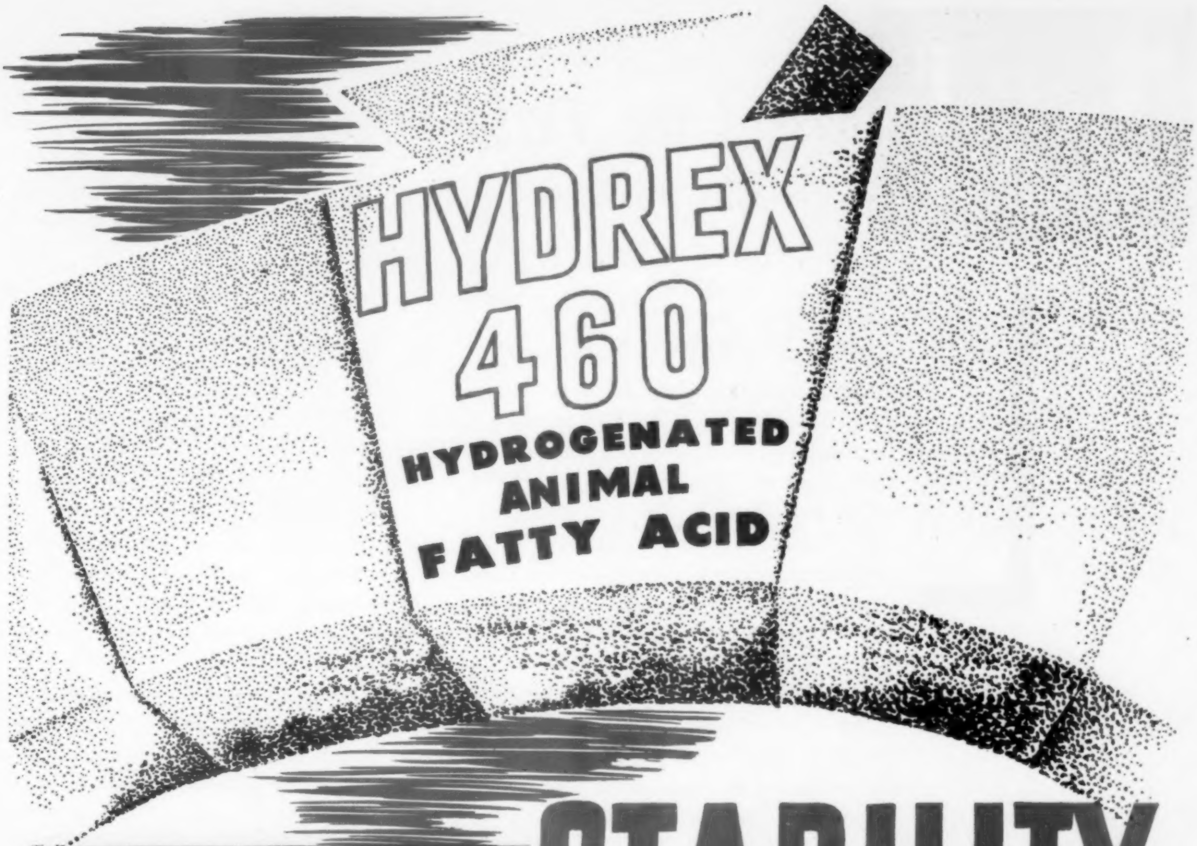
Other Investigations

In addition, investigations are being carried out on:

1. Specifications for Protective Finishes (other than organic) for Metals.

2. Finishes for Non-Ferrous Metals. The purpose is to evaluate and determine performance limits and other data on surface treatments of non-ferrous metals and develop data as required to improve existing treatments.

(*Turn to page 27*)



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HYDREX 460 SPECIFICATIONS

Titre	(134.6-140.0° F) 57.0-60.0° C
Color 5¼" Lovibond Column (max)	4 Yellow-0.4 Red
Iodine Value (Wijs)	1-4
Free Fatty Acid (as oleic)	100-103%
Acid Number	199-205
Saponification Value	201-207

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"lead" passes the *"FRIED EGG"* test*

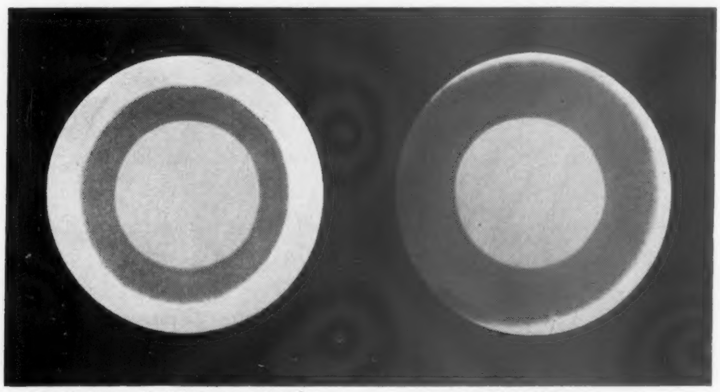
—that's why house paints containing "LEAD" have *extra* durability

The "Fried Egg" test is an interesting and striking comparison of the oil retention properties of a paint film. This simple experiment is carried out by dropping a controlled quantity of paint on a piece of filter paper and observing the area stained by the oil released from the paint. From the illustration, it can be clearly seen that non-"lead" paints give up considerably substantial portions of white lead.

The faculty of white lead to retain the oil in the paint film is a prime requisite of durable house paint films. Without lead pigments, more of the oil binder tends to penetrate the wood or other porous substrata, robbing the oil from the protective film — with consequent early erosion or severe chalking.

Oil-retention is but one of the several reasons why white lead is so desirable in paint. Use enough of it to take advantage of all the qualities that lead pigments impart. You as the manufacturer will know you are producing a better—more reliable product. And white lead pigments in paint can't be beat as a valid argument to promote sales.

Valuable Reference Material: Write for data sheets on paint formulations to meet specific end requirements. *Lead Industries Association, 420 Lexington Avenue, New York 17, N. Y.*



Ready-Mixed White Lead Paint — Non-Lead Paint

Photograph of laboratory test aptly described as the "Fried Egg" test because of resemblance of the end result to an egg fried "sunnyside up."

* *Federal specification TT-P-141b, method 442.1—absorption test.*

"LEAD" LENGTHENS THE LIFE OF PAINT BECAUSE:

It Stabilizes—neutralizes acidic compounds resulting from the decomposition of the vehicle—prevents the film from becoming soft or liquefying.

It Plasticizes—forms lead soaps which increase film flexibility.

It Strengthens—flexible, spiney crystals in lead soaps mechanically reinforce the film and increase elastic strength.

It Resists Water—paint films with an optimum lead pigment content absorb only a small fraction as much water as they otherwise would.

It Limits Oil Penetration—more of the vehicle remains in the film where it is needed; less is absorbed in the substrata.

It Improves Appearance—by controlling chalking and inhibiting mildew.

FILM FORMING MATERIALS Investigation

On Catalytic Solidification

By DR. MAX KRONSTEIN
College of Engineering
New York University

PART TWO

IT IS a known fact that tung oil in contact with anhydrous ferric chloride solidifies into a transparent, resinous, hard substance.

Demmler[5] reported that this reaction is being used commercially for filling interspaces in electrical installations.

It was not known whether this is a true catalytic reaction or if the iron permanently enters the oil molecule in the resulting solid. From the work of C. Devrishian it can be reported that such an entry does not occur, at least not in the insoluble product.

Figure 9 shows the result of solidifying tung oil by the use of anhydrous ferric chloride (2% ferric chloride dissolved in tricresyl phosphate) at room temperature using different amounts of ferric chloride. Here three different amounts of ferric chloride were used with the same quantity of tung oil. The increase in viscosity was observed by the Brookfield Viscosimeter. It is evident from the curves that the rate of formation of the insoluble nucleus of the tung oil differs widely with the amount of ferric chloride. The process of solidification is a rapid one, once it has begun.

Effect of Temperature

THE effect of increasing the temperature is shown in figure 10. Here the reaction which occurred after 200 minutes at room temperature takes place in 5 to 6 minutes at 50° C.

It has been found that Brazilian oiticica oil reacts similarly with anhydrous ferric chloride. However,

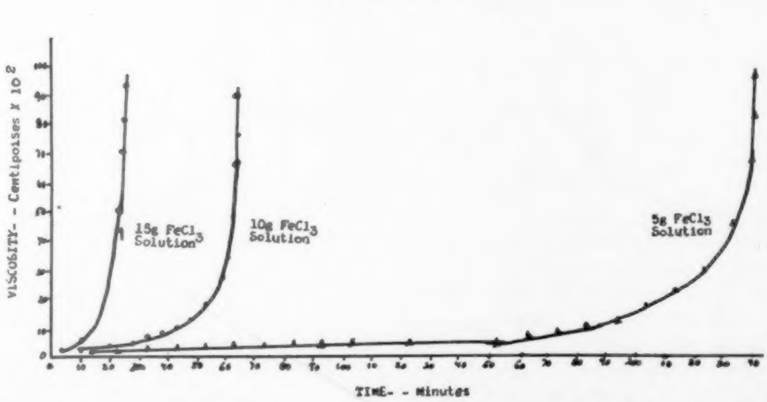


Figure 9. Gelation of Tung oil at room temp. (28C) in presence of anhydrous $FeCl_3$ solutions.

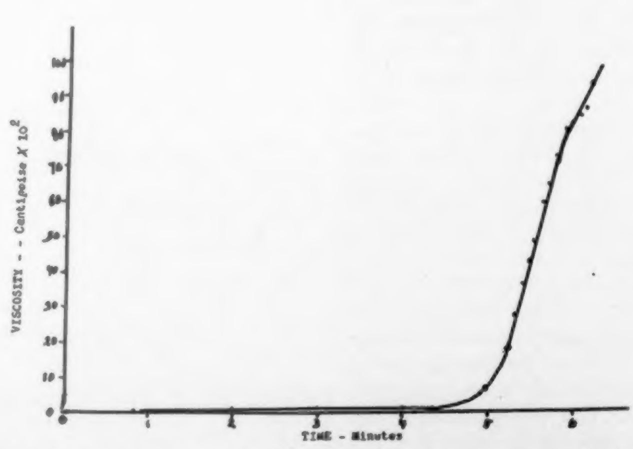


Figure 10. Gelation of Tung oil at 50C in presence of 5 grams of ferric chloride solution.

the reaction is slower and the viscosity curves are considerably different from those of the tung oil. Figure 11 compares the two oils at 28° C. and figure 12 compares them when they are reacted at 50° C.

It was expected at first that other fast drying oils or oils which had been brought chemically to a state of near gelation should show a similar effect with anhydrous $FeCl_3$. This was not so. For instance, linseed oil, which had been modified by vacuum distillation to a point where in continuing the distillation gelation would have occurred, did not react with ferric chloride. Neither did the commercial "conjugated" oils such as "conjulin" and "conjusoy" or chemically modified castor oil react with anhydrous ferric chloride. The reaction seems to be influenced by the particular chemical structure of the oil concerned.

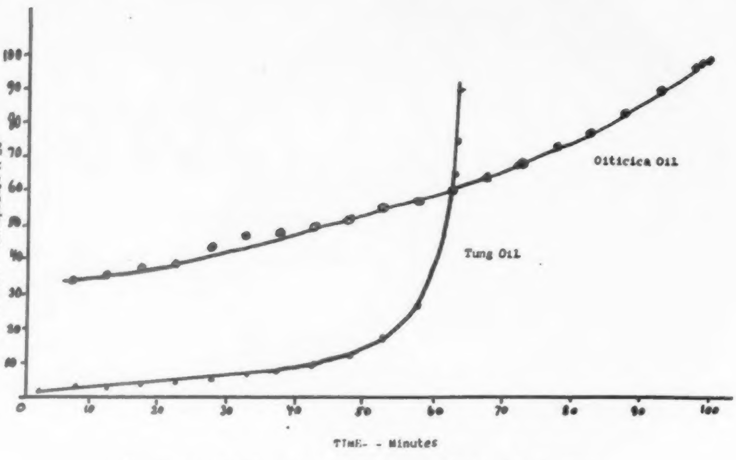


Figure 11. Gelation of Tung oil and Oiticica oil at room temp. (28C) in the presence of 10 grams of $FeCl_3$ solution.

Role of Iron

ONE question which we wished to answer is whether or not in the tung oil-ferric chloride hardening process, iron becomes a permanent part of the insoluble, solid tung oil. Organic analysis as well as the use of infra-red spectroscopy has shown that the iron does not become a permanent part of the tung oil.

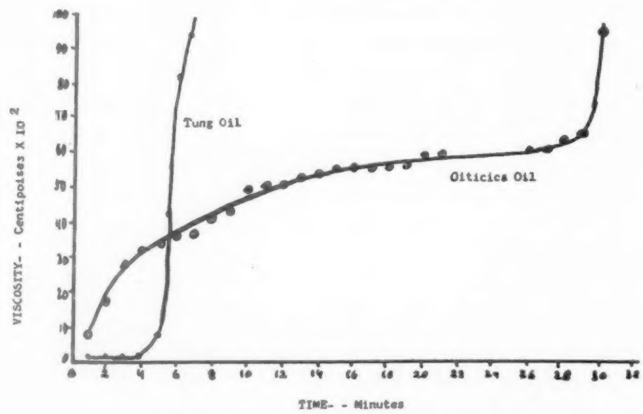


Figure 12. Gelation of Tung oil and Oiticica oil at 50C. in the presence of 5 grams of Ferric Chloride$_3$ solution.

Figure 13 shows the spectra of the toluene-soluble portion of the ferric chloride–tung oil reaction product and of the toluene-insoluble portion of the same material. It should be noted that the transition from the fluid to the solid oil is indicated in these charts under a different plotting (on a % transmission chart) than that shown in more detail before. In presenting these infrared spectra, it appears advisable to show the comparative spectra together, since full structural data on all of the oils and their various states are not yet known. For this reason, in figure 14 there is plotted the spectrum of the solid, insoluble ferric chloride–tung oil product together with the spectrum of a solid tung oil prepared without catalyst (heated in a covered container at 100° C.). While there are a few differences in the intensity of the remaining lines, there is no trace of iron in the reaction product and the two spectra are practically of the same kind.

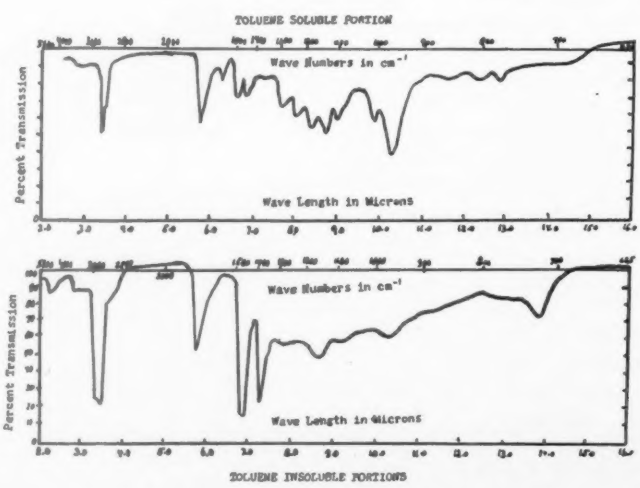


Figure 13. Spectra of toluene-soluble and toluene-insoluble portions of ferric chloride-tung oil reaction product.

Organic ash determinations have been in agreement with the spectrometer tests. In repeated tests, no

ash at all was found. In one case an extremely small amount of ash, due evidently to incomplete solvent purification of the particular specimen, were noted.

Another effect of the catalytic reaction of anhydrous ferric chloride is that in separating the reaction product into toluene-soluble and toluene-insoluble portions only 15.2% soluble substance was found as compared with 23% soluble substance when tung oil was exposed to a temperature of 100° C. without catalysis for 45 days. This indicates that the ferric chloride reaction products contain a greater accumulation of solid units. This is shown in its diffraction x-ray spectrum in figure 15 where the shape of the peak at 19.7 degrees is narrower than that of tung oil solids produced by heat alone. This same closely packed system seems also to be the cause for the less light-permeable appearance of these specimens under the electron microscope. Figure 16 (top) shows the anhydrous ferric chloride–tung oil reaction product in a magnification of 20,000 times.

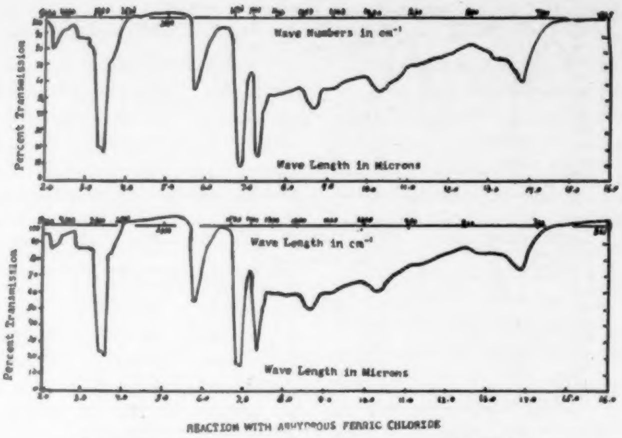


Figure 14. Spectra of solid Tung oil, no catalyst (top) and solid Tung oil prepared with ferric chloride (bottom).

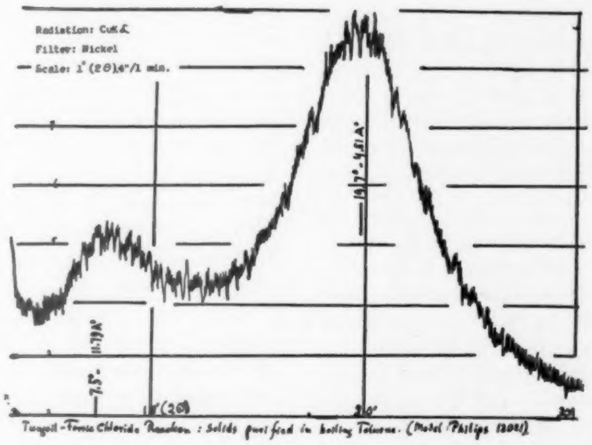


Fig. 15. Diffraction X-ray spectrum of catalyzed Tung oil.

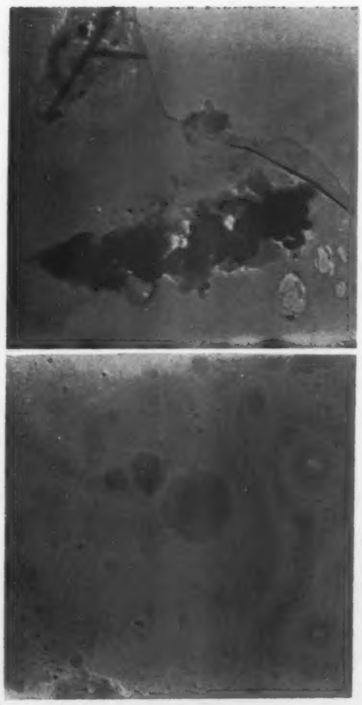


Fig. 16. Electron micrographs. Top: Ferric Chloride-Tung oil product. Bottom: Silicone Tung oil combination. Magnification 20,000 ×.

Metal Halides

IT WAS of interest to see if other metal halides have a similar effect as anhydrous ferric chloride. It was found that, for instance, titanium tetrachloride, silicon tetrachloride and iron fluoride have strong effects on tung oil.

Figure 17 shows the infrared spectrum of the titanium tetrachloride–tung oil reaction product after purification, which is practically identical to the one of the reaction product of anhydrous ferric chloride and tung oil. This concerns itself with the reaction of solid tung oil and other catalysts. In this respect, it has been shown earlier that solid Chinawood oil with a calculated oxygen content of about 18%, when heated at 100° C. in contact with air, increases its oxygen content as high as 27%. It was, therefore, important to investigate if this capacity for adding oxygen can be used in combining oil solids with other materials, or in the formation of new compounds of different compositions.

In studying this problem, the solid phase instead of the initial liquid oil was chosen because it would show also, if such additions occurred at other points during the insolubilization process. This was done by using reacting materials such as organo-sulphur and organo-silane products. It became possible to analyze the resulting product later for sulphur or to ash the product and determine the silicone dioxide and thus calculate the silicone in the new product.

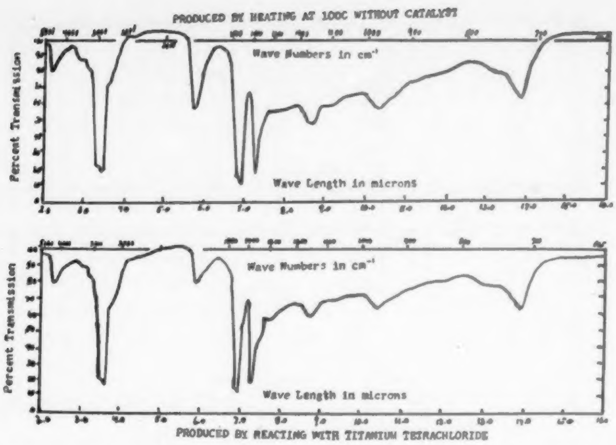


Figure 17. Infrared spectrum of titanium tetrachloride-Tung oil product.

Exposure to Allyl-Sulphides

IN agreement with the test on the oxygen additions which had been made simply by exposing the oil solids to air at 100° C., the oil solids were similarly exposed without catalysts to a surplus of reacting agent. In the sulphur group two compounds were chosen:

1) Allyl Mercaptan C. P. (Edwal Laboratories) H_2C: CH —CH_2—SH where one sulphur is attached to one allyl group (B. P. 67–68° C.)
2) Diallyl Sulfide (Edwal Laboratories) (CH_2: CH—CH_2)$_2$ S, where one sulphur is attached to two allyl groups or where one reactive allyl group corresponds to half a sulphur only.

In view of the wide differences in the oxygen content of a solid tung oil (this means the possible differences in the remaining reactivity of the material) all tests with the sulphur and silicone materials were made from the same solid tung oil. This was prepared by exposing Mississippi tung oil in a covered container to a temperature of 100° C. for 5 days, then removing the surface layer and solvent-purifying the substance underneath and using this as the test material. The analysis of this material is given in Table II, which shows that its calculated oxygen content of 19.20% was relatively low. The importance of this factor will be discussed later.

Corresponding with the exposure to a surplus of air in the oxygen tests, the specimens of solid oil were exposed to about 20 times their weight in the allyl sulphides. No catalysts were used. The exposure temperatures had to be chosen relative to the boiling ranges of the sulphides to avoid loss of material. Therefore, as shown in Table II, the temperature used was 25° C. for the low boiling allyl mercaptan and 50° C. for the higher boiling diallyl sulphides material.

Analytical results indicate that sulphur has entered the substance. In the case where each allyl group was attached to one sulphur twice as much sulphur entered the substance since half of one sulphur corresponds to one allyl group. The resulting substances were still capable of increasing their oxygen content to some extent during purification and drying procedures. These discoveries are of practical importance in that they indicate that even completely insolubilized tung oil, when exposed to reactive chemicals, can undergo a chemical modification. These results also indicate the possibility of coupling tung oil to other groups to form new types of film-formers.

Exposure to Trichlorosilanes

THE primary substance chosen for these tests was vinyl trichlorosilane that is, a silicone with three chlorine groups and one vinyl group. The material was obtained from the *Linde Air Products Company,* and the initial test set-up was the same as with the allyl sulphides reactions.

The reaction was by far more complex in that here two different possibilities of reactivity existed: one, between the unsaturation in the tung oil solids and the vinyl group, and the other caused by the low stability of the silicone-chlorine bond. Another possible reaction was between chlorine and hydrogen contained in the oil solid. The results are shown in Table II.

The reaction was very strong. Heavy acidic vapors were formed which were water-insoluble and oily in nature. The reaction continued for some time during which the solids turned dark brown. These were purified by boiling repeatedly in toluene. To avoid the presence of by-products in the solid matter, only the well-formed solid oil particles were selected for further investigation and all small-sized particles were removed.

In order to test if this product would still react with additional

Material	Percent Hydrogen	Percent Carbon	Percent Sulphur	Percent Oxygen Calculated
Solid Tung Oil	10.13	70.96		
	9.80	70.71		
(100° C after 120 hrs.)	Av. 9.97	Av. 70.84		19.20
Solid Tung Oil	9.47	66.66	0.76	
	9.53	66.72	0.71	
(Exposed to Diallyl Sulfide at 50° C)	Av. 9.50	Av. 66.67	Av. 0.74	23.10
Solid Tung Oil*	9.03	65.84	1.56	
	9.06	66.04	1.55	
(Exposed to Allyl Mercaptan at 25° C)	Av. 9.05	Av. 65.95	Av. 1.56	23.45

* Specimens were purified in ether and dried at 100° C.

TABLE II

vinyl trichlorosilane, it was again exposed to vinyl trichlorosilane. The reaction this time was by far less violent, but the analysis shows that additional silicone entered the compound.

In order to determine how far the vinyl group and how far the chlorine entered into the tung oil modification, tests were repeated using another trichlorosilane, carrying another organic radical without its own double-bond, ethyl trichlorosilane. The reaction was by far less stormy. The analytical tests of the resulting solids showed that somewhat more than half the amount of silicone was found in the sample as in the sample made with the vinyl material.

Finally for testing, if the chlorine groups had been participating in these reactions, the tests were made with another silane, ethyl triethoxy silane. The same test conditions were used. Here, there was no gas development and hardly any change occurred in the appearance of the oil solids. Indeed, less than 1% silicone was found in the resulting product. It is not known if this small amount was actually chemically bound to the oil.

Material	Percent Hydrogen	Percent Carbon	Percent Ash	Calculated Percent Silicon	Calculated Percent Oxygen
A Solid Tung Oil[1]	10.13	70.96			19.20
	9.80	70.71			
(Produced by exposing at 108° C. for 120 hrs.)	Av. 9.97	Av. 70.84			
B Solid Tung Oil			13.25	6.1	
			13.18		
Exposed to Vinyl Trichlorsilane[2]			Av. 13.22		
			21.41	10.00	
Vinyl Trichlorosilane[3]			21.37		
Exposed a second time to			Av. 21.39		
C Solid Tung Oil[4]			12.58	5.86	
			12.51		
Exposed to Ethyl Triethoxysilane			Av. 12.55		
D Solid Tung Oil[4]			1.98	0.89	
			1.85		
Exposed to Ethyl Triethoxysilane			Av. 1.92		

[1] Material on the surface was not removed and therefore contained a higher oxygen content.
[2] 20 grams of oil solids and 190 grams of reagents reacted 20 hrs. at 28° C and 6 hrs. at 50° C.
[3] In second test 16 parts of first treatment and 54 parts of reagent reacted at 28° C for 60 hrs.
[4] Same conditions apply as in C.

TABLE III

Material	Percent Hydrogen	Percent Carbon	Percent Ash	Calculated Percent Silicon	Calculated Percent Oxygen
A Solid Tung Oil*	8.48	64.28	8.83		
	8.52	65.50	8.93	4.10	23.01
(Exposed to 100° C for 120 hrs.)	Av. 8.50	Av. 64.39	Av. 8.88		
B Soft Florida Tung Oil					
Exposed to Vinyl Trichlorosilane			16.80	8.08	
Exposed to Ethyl Trichlorosilane			14.90	7.00	
Exposed to Amyl Trichlorosilane			11.20	5.56	
C Solid Tung Oil	9.90	72.57			17.75
	9.68	72.35			
(Anhydrous Ferric Chloride)	Av. 9.79	Av. 72.46			
Same oil exposed to Vinyl Trichlorosilane			5.10	2.38	

* Material on the surface was not removed and therefore contained a higher oxygen content.

TABLE IV

Table IV shows that this reaction does depend on the reactivity of the oil specimen. Employing another tung oil (A, Table IV) which had been heated longer and had not been separated from that portion in contact with the air (higher oxygen content) resulted in less silicon entering the compound during the first treatment with vinyl trichlorosilane (4.10% instead of 6.1%). On the other hand, using tung oil solids which had not been exposed to the temperature of 100° C., as much as 8% silicone entered the matter.

Another interesting fact which is shown in Table IV is that the anhydrous ferric chloride–tung oil reaction product had less oxygen according to the analysis but takes on less silicone inspite of corresponding test conditions.

Technically these tests were of interest because they showed that indeed the oil can be coupled with additional reactive groups without requiring points in its structures which would be required in the insolubilization of the oil substance itself. Figure 16 (bottom) shows the electron micrograph of a solid form of a silicone-oil compound.

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Joseph J. Alicino.

The work reported here was done in the paint research laboratories of the College of Engineering, New York University in cooperation with M. M. Ward, Robert Roper and George MacNiece.


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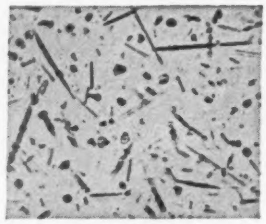

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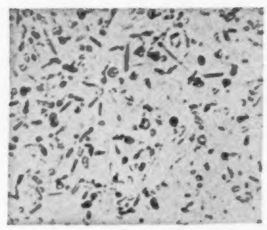

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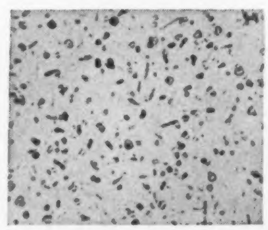

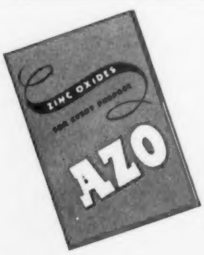

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Vinyls
For Surface Coatings
Part II

By
WALTER J. HANAU, Chemical Engineer

VERY widely different vinyl polymers are on the market, their properties depending on chain structure as well as on the modifying groups contained in the monomer molecule. In discussing the polymers available, the various monomers should be identified, and the commercial polymers and copolymers referred back to the monomer or monomers constituting them. Writing the monomer as $H_2C=C\begin{smallmatrix} \diagup X \\ \diagdown Y \end{smallmatrix}$ substituents for X and Y which describe the major monomers used are presented in Table 1.

Polyethylene

THESE substances owe their remarkable properties to molecular streamlining. The polymer consists of a chain of $—CH_2—$ groups for polyethylene and of $—CF_2—$ for polytetrafluoroethylene. These resins possess considerable toughness and remarkable resistance to chemicals and solvents. Polyethylene is a waxy resin which softens noticeably at 108 to 112° C, but retains considerable body above this melting point because of its structural peculiarities. It also possesses toughness, shock resistance and inherent flexibility (independent of the molecular weight of resin) over a wide temperature range (from –70° C to 90–100° C). Other properties include extreme low water absorption and moisture vapor transmission, and very low specific gravity. While insoluble in all organic solvents at room temperature, polyethylene is soluble in carbon tetrachloride, trichloroethane, aliphatic and aromatic hydrocarbons above 50 to 60° C and may be applied in hot solution using solvents which boil above the melting point of the resin. "Teflon," Dupont's polytetrafluroethylene exhibits good toughness and may be used over a temperature range of – 320° F to 550° F.

It is unaffected by boiling organic solvents as well as practically all chemicals except molten alkalai metals. "Teflon" finishes are characterized by outstanding corrosion resistance (subject to freedom from pinholing) and heat resistance. Only water dispersions can be used but fusion at 750° F after air-drying is necessary in order to produce a continuous film. Due to its heat resistance, the use of a blow torch or a similar burner is feasible for fusing "Teflon," coating materials employing "Teflon" as a base have application as primers for aluminum and steel. They may also be used as finishes for ceramics. "Teflon" enamels have also been useful in high-heat applications. Dipping, flowing or spraying are methods used to apply this material.

Brush application on a large scale is prevented by coagulation due to mechanical working. The polymers discussed show very poor adhesion to most materials, except for certain low-polarity polymers such as butyl rubber, which adheres to polyethylene. Adhesion to metals is greatly increased by the flame-spraying processes in which resin particles are entrained, molten, and deposited by hot gases. These show improved adhesion to metal substrates and have been found very useful in application of heavy protective coatings such as tank linings where a thickness of 150 to 30 mils is necessary. Dispersions of polytrifluoromonochloroethylene employing xylol for dilution is claimed to have excellent dispersion stability.

Polyisobutylene

X-RAY studies indicate that the polymer molecule

$$(C(CH_3)_2—CH_2—)_n$$

has a spiral twist in its relaxed state, thus rendering crystallization difficult and accounting for the rubbery character of this material.

Polyisobutylene is produced commercially in a range of molecular weights, from tacky semi-solids to rubbery materials of much less plasticity. Blending, for all except the low-molecular-weight grades, must be performed on a rubber mill. Polyisobutylene plasticizes rubber, and imparts flexibility to waxes and asphalts. In vulcanized rubber, where its presence improves the resistance to vegetable oils, ozone, acids and alkalies, it must be taken into account when figuring the amount of sulfur to be used, since polyisobutylene absorbs sulfur physically. It is also used in rubber cement to improve aging characteristics and to lessen permeability to gases, moisture, etc. It is soluble in hydrocarbons, turpentine, and some chlorinated solvents. Polyisobutylene depolymerizes slowly on exposure to heat, ultraviolet radiation and oxygen.

Fortifying waxes—In order to eliminate the blending step on rubber mill mentioned above for the use of polyisobutylene and similar polymers in flexibilizing waxes, various concentrates of these materials in wax are on the market which can be incorporated into a larger amount of wax simply by melting together with moderate agitation. Generally speaking, this increases the tensile strength, seal strength, flexibility, molten tack, and resistance to moisture vapor transmission.

Among the polymers available for this application are polyisobutylene-wax blends and concentrates of poly-

		TABLE 1	
X	Y	MONOMER	CHARACTERISTICS OF POLYMER
H	H	Ethylene	Good chemical and solvent resistance, good electrical and aging properties
H	(phenyl)	Styrene	Same as polyethylene but lower solvent resistance
CH_3	CH_3	Isobutylene	Same as styrene
H	COOR	Acrylate	Good clarity and color retention
CH_3	COOR	Methacrylate	Same as polyacrylate
H	Cl	Vinyl chloride	Tough, good chemical and solvent resistance
Cl	Cl	Vinylidene chloride	Same as polyvinyl chloride
H	CN	Acrylonitrile	Same as polyvinyl chloride
H	OAc	Vinyl Acetate	Good resistance against aging and ultraviolet light
H	OH	Vinyl alcohol	Oil resistant and water soluble

ethylene, butyl rubber, and S polymer in various waxes. S polymer, a hard, resinous copolymer of isobutylene and styrene is characterized by low moisture permeability.

Diene copolymers—In connection with butyl rubber discussed above for fortifying waxes, a brief summary of the copolymers of butadiene with vinyl monomers seems advisable. The main advantage of butyl rubber, the copolymer of isobutylene and butadiene, is its vulcanizability while largely retaining the resistance characteristics of polyisobutylene. Buna S, butadiene-styrene copolymer and Buna N butadiene-acrylonitrile copolymer show good high-temperature and aging resistance for use as plasticizers. Styrene rubber is a butadiene-styrene copolymer of a higher styrene content compared to Buna S. It shows excellent aging characteristics and improved quality for electrical applications at the expense of some of the high-temperature and solvent resistance of Buna S.

Coumarone-Indene

THESE are polymers and copolymers consisting mainly of coumarone and indene, and also possibly containing methyl-coumarone and dimethyl-coumarone. They are obtained mostly from coal-tar byproducts; e.g., crude coal-tar naphtha distilling between 155 and 185° C contains about 35% polymerizable materials of this type. The degree of polymerization of these resins is usually 4 to 9 units per chain, but a high of 35 has been obtained. For a high degree of polymerization, $SnCl_4$ is recommended as a catalyst, while sulfuric acid is generally used as catalyst because of its low cost.

Resins of this type are soluble in coal-tar solvents, moderately soluble in petroleum solvents, and can be incorporated into vegetable oils by heating. By far the largest use is for neutral, chemically resistant varnishes, by virtue of the low acid number and inactivity of the resins. Their use in printing inks with or without addition of resin oils is recorded. These resins are useful as extenders in plasticizing polyvinyl chloride-acetates, but are not applicable where low volatility and low-temperature flexibility are required. The cost of the dark resins (from byproducts) is usually low; purer raw materials yield resins of good color, but of considerably higher price.

Polystyrene

STYRENE polymers are used almost entirely in molding applications because their lack of flexibility makes them unsuitable for most coatings. They are stated to be very resistant to water as well as strong acids and alkalies and oxidizing acids.

The monomer $H_2C = CH\phi$ is usually produced by reacting benzene and ethylene ($AlCl_3$ catalyst) to produce ethylbenzene, followed by dehydrogenation to yield styrene. The monomer as found in coal tar is usually not pure enough for satisfactory use in polymerization.

Polystyrene has been recommended in surface coatings because of the possibility of using cheap hydrocarbon solvents and because of its light color, good color stability, and toughness.

There are, however, commercial grades of polystyrene available for surface coatings. These are water-white thermoplastic, highly resistant to water, acids, alkalies and alcohols. Toughness and melting point increases with increasing molecular weight. Recommended solvents include mixtures of aromatic and aliphatic hydrocarbons; leaner solvents being used for the lower viscosity resin grades i.e. a higher proportion of aliphatics.

These grades of polystyrene are compatible with a wide range of common plasticizers, but they show a behavior described as a sharp "threshold" concentration. Below a definite concentration of plasticizer the resin is brittle. As the plasticizer content is increased above this critical value ("threshold" concentration), the film very quickly becomes very soft and tacky. For this reason plasticizers cannot be used to modify film properties, but only to aid solvent release and to modify viscosity thereby improving sprayability. The "threshold" concentration is usually in the range of 20 to 40%, depending on the plasticizer used. For any one plasticizer, it is at a definite value regardless of the molecular weight of the polystyrene used. Resins compatible with polystyrene include mainly the phenolics and coumarone-indene resins. These improve gloss, and in some cases, adhesion. They are added to lower the viscosity at a given solids content and thereby improve sprayability. Polystyrene is not compatible with alkyds, vinyls, acrylates, cellulose derivatives and polybutene.

Polystyrene Emulsions

POLYSTYRENE emulsions (Bakelite) when properly plasticized, form tough, water-resistant protective coatings. Whether this improved plasticizer acceptance as compared to the behavior of solution grades described above is due to higher mo-

(*Turn to page 41*)

CATHODIC PROTECTION

(From page 11)

tial was applied across the coating. In very high resistance electrolytes, a larger portion of the potential drop between galvanic anodes and steel occurs in the electrolyte thus limiting the potential gradient across the film.

Coating Development

ALTHOUGH there are several coatings which function quite well when used in conjunction with controlled cathodic protection, it is felt that much can be gained by developing special paint coatings to be used with cathodic protection. Such coatings need not possess all the attributes required if they were to function independently of cathodic protection.

Since many underwater structure surfaces are irregular in shape or else represent the inner circumference of a cylinder, there appears to be some limit to the use of wrapper under tension to reinforce coatings such as are used in the protection of buried pipelines.

There appears to be several directions to look for developing coating specifications to be used with cathodic protection.

First, we can consider the possibility of an ideal coating having high resistivity, high adhesion, resistance to alkali, impermeability to water, high tensile strength, etc. Vinyl systems, coal tar enamels and others possess these properties to some extent. However, no coating has an absolute resistance and the systems named are susceptible in time to electroendosmosis if an excessive potential gradient is applied. Thus, it is essential that the cathodic protection be controlled carefully to obtain the maximum protective benefit from a joint system.

Secondly, there is the possibility of using a coating system with a relatively low resistivity, high adhesion, high resistance to alkali, and a sufficiently porous structure so as to permit diffusion outward of the cathodic product. Such a coating uniformly applied would function more as a diffusion barrier layer than as a resistance. A coating possessing this general character would act similar to scale-forming salts deposited from water.

The high resistance coatings will usually require the least protective current but will need closer regulation of the cathodic protection system to obtain the best overall protection.

References

1. Sudrabin, L. P., Water Works and Sewerage, 92, No. 6, R(67–79), 1945.
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3. Brown, R. H. and English, G. C. "Cathodic Protection" Symposium, Electrochemical Society and N.A.C.E., 7–11, 1949.
4. Kittelberger, W. W. and Elm, A. C., Industrial and Engineering Chemistry, 37, No. 7, 876-81, 1947.

PROTECTIVE COATINGS

(From page 14)

3. Electro-Deposited Metal Coatings. The purpose is to determine quality standards for various electro-deposited metal coatings; develop and evaluate special coatings, and investigate the effects on the base metal.

4. Phosphate Finishes and Treatments. The purpose is to develop and/or evaluate solutions and methods for phosphate finishes and treatments (other than paint bases).

5. Oxide Finishes and Treatments. The purpose is to evaluate and determine performance limits and other data on oxide finishes, and develop data as required to improve existing treatments.

6. Sealing Compounds. The purpose is to evaluate and determine performance limits and other data on sealing compounds for Ordnance application; obtain improved properties and characteristics in such materials where required; provide engineering data for use in applications; develop or improve test methods; and conduct qualification testing as required by applicable specification.

7. Barrier Materials. The purpose is to evaluate and determine performance limits and other data on all types of barrier materials for Ordnance packaging application, obtain improved properties and characteristics in such materials where required; provide engineering data for use in applications; develop or improve test methods; and conduct qualification testing as required by applicable specifications.

8. Specifications for Organic Coatings. The purpose is to prepare and revise specifications for organic protective coatings (including metal treatments prior to painting).

9. Surface Preparation of Metals. The purpose is to evaluate the effectiveness of metal treatments to improve adhesion of paint systems and prevent corrosion, and evaluate methods of cleaning prior to painting.

10. Primers for Metals. The purpose is to evaluate various pigment and vehicle formulations, pigment volumes, film thicknesses, etc. for the improvement or development of metal priming paints.

11. Finishing Coat Systems. The purpose is to evaluate various pigment and vehicle formulations, pigment volumes, film thickness, etc. for the improvement or development of finish coats (including undercoats other than primers).

12. Synthetic Resins. The purpose is to investigate synthetic resins used in coating materials for identification and quantitative determination of constituent materials.

13. Fungicides in Organic Coatings. The purpose is to study the effectiveness of wood sealers and fungicides in wood and their effect on subsequent paint coats; to evaluate fungicides in organic coatings.

14. Materials and Methods for Protection Against Fungi. The purpose is to evaluate, improve, and/or develop materials and methods for use in protection of Ordnance material against deterioration caused by fungi.

Personnel

The personnel engaged in research and development on protective coatings for the Ordnance Corps. are: Mr. C. R. Cornthwaite, Research and Development Division, Materials Branch, Office, Chief of Ordnance, Washington 25, D. C.; Dr. C. F. Pickett, Chief, Paint and Chemical Laboratory, Aberdeen Proving Ground, Md.; Mr. T. Rice, of Rock Island Arsenal Laboratory, Rock Island Arsenal, Rock Island, Ill.; and Mr. M. Frager, of Pitman Dunn Laboratory, Frankfort Arsenal, Philadelphia 37, Pa.

NEW PRODUCTS & IMPROVEMENTS

A MONTHLY MARKET SURVEY

CHAS. ROSS & SON

MIXER

Liquids and Semi-Pastes

Available in sizes from 50 to 1,500 gallons (or larger), this mixer, with slight changes in the stirrer arrangement, can be used also as an agitated storage tank in the larger sizes. Paste or liquid type stirrers can be furnished, as desired, and the unit may be mounted through the floor or otherwise to suit space and other requirements. The motor is a right angle gearhead reduction type and is directly connected to the stirrer shaft. This arrangement makes for a more compact unit and eliminates intermediate parts such as chain drives and gears, thereby minimizing breakdown possibilities. Ross & Son Co., 148 Classon Ave., Brooklyn, N. Y. PVP—May.

ANTIOXIDANT

For Paints, Emulsion, Resins

"Wing-Stay" S is an amber liquid consisting of a blend of substituted phenolics. It is soluble in most organic solvents and insoluble in water. However, it is soluble up to 10% by weight in aqueous alkaline solutions. This material is suggested as an antioxidant for light-colored rubber compounds. Other potential usage is foreseen as an antioxidant or stabilizer in paints, wax emulsions, resins, polymer solutions, and polymer-wax combinations. According to the manufacturer, this material has good heat stability and low volatility thus permitting complete incorporation in rubber with minimum loss by volatilization and no danger to the protective effect of the antioxidant. The Goodyear Tire and Rubber Co., Akron, Ohio. PVP—May.

CLARK HOPKINS

HAND TRUCK

Dual Purpose

This combination hand truck and stacker is used for loading and unloading heavy cases and barrels from ground level where loading docks are not available. It is designed to fill the need for a small, light-weight, highly maneuverable, hand truck that will enable one man to load and stack heavy merchandise, after transporting from one location to another. Clark-Hopkins Equipment Corp., Philadelphia 23, Pa. PVP—May.

SILICEOUS EXTENDER

Low Oil Absorption

"Gartex GP" is a finely-divided siliceous material consisting of 85 percent water-ground silica and 15 percent ground glass. The material is quite fine, 99 percent passing through a 325-mesh sieve. The oil absorption (rub out) is 25. Other outstanding characteristics are freedom from settling and high resistance to abrasion. It is supplied in bulk and 50-lb. paper bags. Garco Products, Inc., Post Office Box 351, Butler, Pa. PVP—May.

VINYL LATEX

Moisture-Resistant

A new vinyl latex for use in the paper, textile and paint industries is now being offered. Called Dow Latex 744-B, this new product is the result of extensive research on vinyl chloride and the vinylidene chloride monomer and their copolymers.

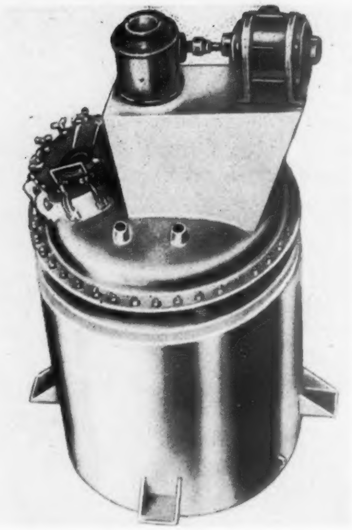
This new latex is designed to serve both as a functional coating material and as a pigment binder. According to the manufacturer, this latex will give resistance to moisture, chemical and grease in functional paper coatings and will produce fire and chemical resistant paints. This product should find widespread use in military applications. For further details write to the Dow Chemical Co., Midland, Mich. PVP—May.

RUBBER DRUM

Collapsable Type

Fifty-five gallon synthetic rubber-fabric drum, suitable for shipping liquids, which can be collapsed after emptying, is returnable and reusable.

Experimental tests conducted by U. S. Rubber indicate that the new drum will be suitable for the shipment of oils, greases, fats, acids, paints, emulsions, etc. This drum weighs less than 30 pounds. U. S. Rubber Co., 1230 Ave. of the Americas, New York, N. Y. PVP—May.



L. O. KOVEN

HEAVY DUTY MIXER

A.S.M.E. Type

Heavy duty A.S.M.E. mixer is designed for processing and blending viscous compounds, such as plastic compounds, heavy chemical solutions, solids suspended in heavy liquid vehicle, and the like.

The 36" diameter mixer is welded in accordance with Paragraph U-69, A.S.M.E. Code, for vacuum operation. A full steam jacket is provided for heating the product during the mixing process. The cover which is gasketed and bolted to the tank is provided with an 11" × 15" hinged manhole and a 4" sightglass. The outlet valve is located on the bottom of the tank. A thermowell projects into the side of the tank near the bottom.

An 18" diameter turbine type impeller is driven at approximately 125 r.p.m., by a 2 h.p. explosion-proof motor through a speed reducer. To augument the impeller, three baffles have been equally spaced in the tank, projecting radially along the cylinder but mounted one inch away from the cylinder wall. L. O. Koven & Brother, Inc., 154 Ogden Ave., Jersey City 7, N. J. PVP—May.

STEARIC ACIDS

Powdered Form

All grades of Emersol Stearic Acids in a "extra-fine" powdered form is now available.

Laboratory screen test results for these new powdered Emersol Acids show that 99.5% pass thru a U.S. #30 Sieve (0.0232 inch openings) and 95% thru a U.S. #100 Sieve (0.0059 inch openings). This is compared to typical material heretofore available of which 96% passes thru a U.S. #30 Sieve and only 70% passing thru a U.S. #100 Sieve.

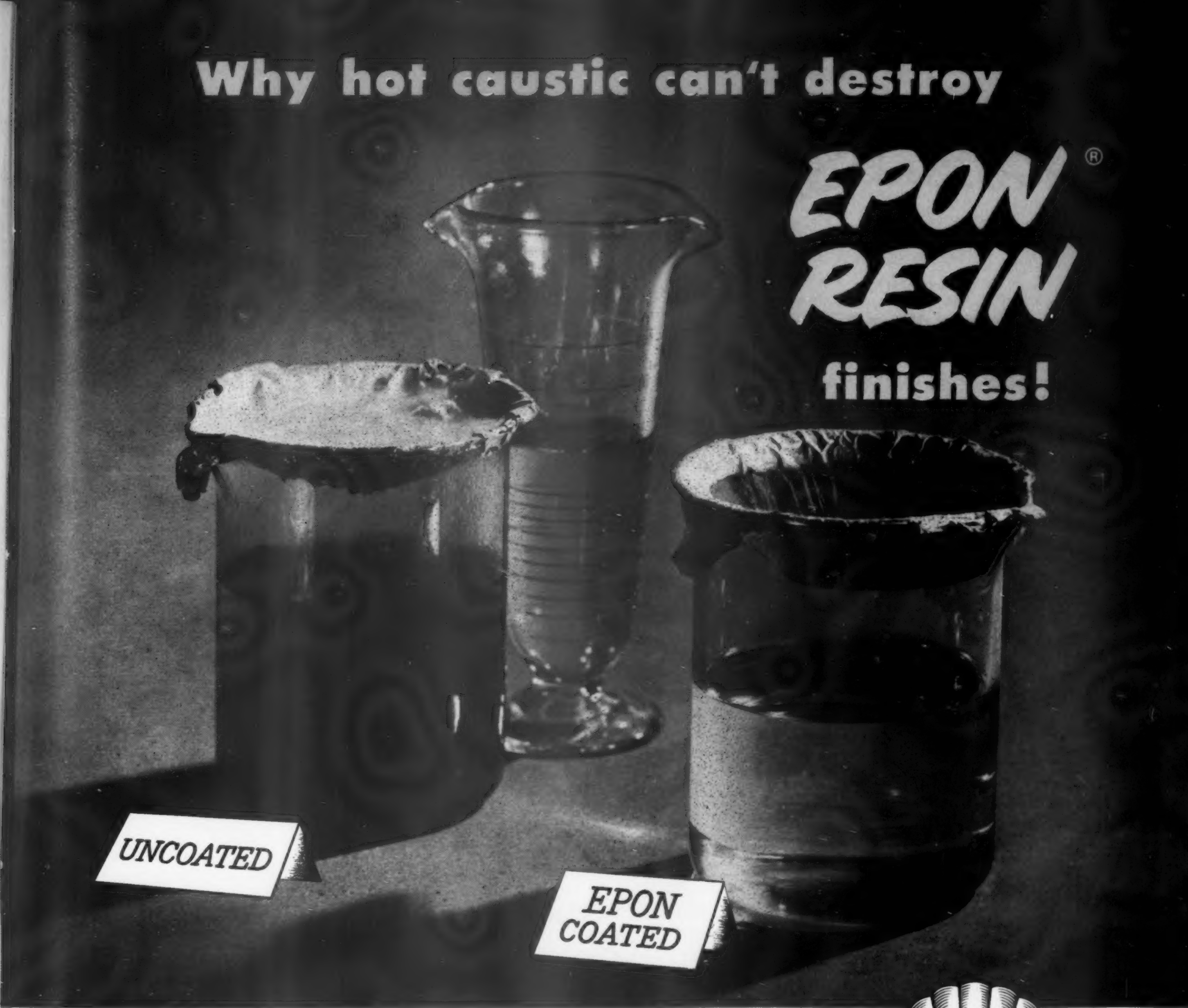
Their affinity for metals fascilitates grinding of metallic pigments and powders. Also gives excellent leafing characteristics to bronze and aluminum pigments; makes metal powders oxidation resistant and free flowing. Emery Industries, 4300 Carew Towers, Cincinnati, Ohio. PVP—May.

RICINOLEATES

Pilot Plant Quantities

Barium, cadmuim, calcium, magnesium, and zinc ricinoleates are available. Samples from pilot plant facilities may be obtained on request. Larger amounts will be supplied for customer experimental production runs if required. Regular production in volume is expected in the near future.

Current studies of these ricinoleates indicate that they parallel or surpass the performance of metallic stearates in their many applications. The Baker Castor Oil Co., 120 Broadway, New York 5, N. Y. PVP—May.



Thousands of surface finish manufacturers all over the country saw this test . . . and were amazed!

The Set-Up. On the left beaker: a standard aluminum foil. On the right beaker: more of the same aluminum foil, but with its underside coated with an Epon resin enamel. In both beakers: an indicator liquid. Poured on each sheet of foil: hot 20% caustic solution.

The Result. On the left: the caustic eats through the aluminum foil in 12 seconds. On the right: the foil dissolves here, too, but the Epon coating is unaffected. The caustic remains suspended indefinitely *by the Epon film alone!*

The Reason. Epon resins are an entirely new class of polymer—with *an ether linkage* instead of the usual ester bond. Epon has unparalleled resistance to detergents, caustics, many acids and stain-producing agents. And . . . Epon's inertness is backed up by outstanding flexibility and toughness.

The demand for Epon resins is ahead of present production. Increased capacity is on the way. Now is the time to develop formulations based on these new resins. Experimental quantities may be obtained for evaluation.

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Alkyd Coating

U. S. Patent 2,537,949. Harold E. Adams, Lancaster, Pa., assignor to Armstrong Cork Company, Lancaster, Pa., a corporation of Pennsylvania.

The process of forming a coating composition which comprises, condensing approximately 4.0 moles of rosin with approximately 6.0 moles of maleic anhydride to form a tribasic acid, adding approximately 2.0 moles of linseed oil fatty acids, approximately 6.4 moles of diethylene glycol and approximately 2.0 moles of glycerine thereto and causing a reaction to occur, and stopping the reaction before the formation of a gel.

Flameproof Coating

U. S. Patent 2,536,978. Frederick Fordemwalt, Bound Brook, N. J., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine.

A stable, heterogeneous, oil-in-water type emulsion, adapted for the simultaneous deposition on fabrics from an aqueous medium of fire-resisting, coloring and binding materials, which emulsion is comprised of a continuous dispersion medium comprising water, containing a hydrophilic colloid; a dispersed phase comprising a film-forming, substantially colorless fire-resistant, water-insoluble, non-volatile, chlorinated organic compound capable of liberating HCl at elevated temperatures, a colorless, fire-retarding pigment, and a hydrocarbon solvent; a separately dispersed phase comprising water-insoluble organic solvent, at least one coloring pigment and an uncured, heat-convertible, binder resin, selected from the group consisting of (*a*) the drying-oil-modified alkyd resins, (*b*) the organic hydrocarbon solvent-soluble, amide-aldehyde resins and (*c*) mixtures thereof; and a water-soluble soap of a higher fatty acid, the proportions as weight percentages of the total emulsion being 0.1–10% hydrophilic colloid, sufficient chlorinated organic compound to provide from about 2–12% of combined chlorine capable of liberating HCl at elevated tempertaures, 5–30% fire-retarding pigment, 0.5–10% binder resin and 0.25–4.0% soap.

Drying Oil-Dimer Copolymers

U. S. Patent 2,536,845. Anthony H. Gleason, Westfield, N. J., assignor to Standard Oil Development Company, a corporation of Delaware.

The process of preparing polymerization products which consists of heating to a temperature of 250 to 400° C. from 5 weight percent to an equal amount by weight of a fatty drying oil with a member of the group consisting of the cyclic dimer of butadiene-1,3 and the cyclic dimer of piperylene until a resin is formed.

Aqueous Emulsion Paints

U. S. Patent 2,537,005. Francis Patrick Hiron and Philip James Garner, Chester, England, assignors to Shell Development Company, San Francisco, Calif., a corporation of Delaware.

An aqueous emulsion paint comprising an aqueous emulsion of a neutralized mixture of substantially oil-free naphthenic acids and associated film-forming constituents form a naphthenic acid-containing petroleum fraction boiling above 200° C. at 0.5 mm. mercury pressure, together with a dispersed pigment.

P V C Emulsions

U. S. Patent 2,536,470. Daniel Schoenholz, Bronz, N. .Y, and George O. Morrison, Milltown, N. J.

A coating composition, comprising, as essential constituents a stable emulsion-polymerized aqueous polyvinyl acetate emulsion containing as emulsifying agent high molecular weight organic hydrophylic colloid having substantially only the hydrophilic groups effective at a concentration ranging from about .5% to 4% by weight of the emulsion, plasticizer for polyvinyl acetate in an amount within the range from 12% to 50% by weight of the polymer and effective to cause water-resistant pliable film formation, and at least one added water-soluble synthetic surface active agent having both hydrophilic and hydrophobic groups effective and selected from the group consisting of non-ionic, anionic and cationic surface active agents in an amount within the range from 20% to 75% by weight of the plasticizer and effective to prevent coalescence of the resin particles when the emulsion has been subjected to freezing and thawing, said composition being free from solvent odor, capable of forming a film resistant to water and to the effects of washing and scrubbing with aqueous materials.

Coating Composition

U. S. Patent 2,537,019. Gerald R. Barrett, Winchester, Mass., assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware.

A coating composition consisting of a resinous homopolymer of polymerized vinyl chloride having a molecular weight in the range of 5,000 to 50,000, said homopolymer being present in an amount of about 5 weight percent, dissolved in a solvent medium consisting in combination of 44% by volume of cyclohexanone, 48% by volume of methyl ethyl ketone, and 8% by volume of toluol, said resin being present in the composition in an amount of approximately 5% by weight.

Film-Forming Latex

U. S. Patent 2,538,737. George William Stanton, Contra Costa County, Calif., and Charles Everett Lowry, Midland, Mich., assignors to The Dow Chemical Company, Midland, Mich., a corporation of Delaware.

The latex-like dispersion of a ternary copolymer obtained by polymerizing together a mixture of 90 per cent vinylidene chloride, 2.5 to 3 per cent acrylonitrile and the balance, from 7.5 to 7 per cent of ethyl acrylate dispersed in water in a ratio of from 45 to 60 per cent of the mixed monomers and correspondingly from 55 to 40 per cent of water, in the presence of an anionic emulsifier and a peroxidic catalyst, at a pH between 1.5 and 6.5 until polymerization is substantially complete, said copolymer latex being capable of depositing flexible and elastic films and coatings which are continuous and highly impervious to moisture when dried at room temperature.

Stable Vinyl Compositions

U. S. Patent 2,538,297. Willem Leendert Johannes de Nie, Amsterdam, Netherlands, assignor to Shell Development Company, San Francisco, Calif., a corporation of Delaware.

A heat and light-stable homogenous composition comprising polyvinyl halide resin and from 1 to 10%, in terms of the weight of said resin, of the salts of a metal selected from the group consisting of lead, silver and mercury with the mixture of acids obtained on saponification of wool fat.

abstracts

Resorcinol-Formaldehyde Reaction Observations

Paul J. Stedry, Minnesota Mining & Manufacturing Co., St. Paul, Minn. Presented at Div of Paint, Varnish, and Plastics Chemistry of the American Chemical Society at Chicago Meeting, Sept. 3–8, 1950.

The course of sodium hydroxide-catalyzed reaction between resorcinol and formaldehyde in dilute solution can be followed by measuring transmission in the near ultraviolet of samples withdrawn at regular intervals. Formation of condensation products causes a gradual decrease in transmission of the solution which serves as an index of the reaction velocity, the rate of the decrease being proportional to temperature.

Ultraviolet transmission data were used to compare condensation rates during reactions between 1 mole of the resorcinol and 1, 2, or 3 moles of formaldehyde at temperatures varying from 55° to 110°F. Temperature coefficient and activation energy were calculated. Examples are given to illustrate how similar measurements can be applied to study the effects of various catalysts and concentrations.

Applicability of this method is restricted to condensation reactions which take place in a single phase without appearance of turbidity. Presence of formation of quinonoid bonds is a principal source of error.

Corrosion Resistance of Phenolic Resins

Raymond B. Seymour, The Atlas Mineral Products Co., Mertztown, Pa. Presented at Div. of Paint, Varnish, and Plastics Chemistry of the American Chemical Society at Chicago Meeting, Sept. 3–8, 1950.

Because of their outstanding resistance to solvents, salts, and non-oxidizing mineral acids, coatings, chemical equipment, and cements derived from phenolic resins are used widely in the chemical, steel, paper, petroleum, food, textile, and plating industries. Practical experience and laboratory test data show phenolic resins to be unsuitable for use in presence of nitric acid, chromic acid, or strong alkalies, but to be resistant to most other common industrial chemicals at temperatures up to 375° F.

A test procedure has been developed in which the weight change of phenol-formaldehyde coupons is determined for various time intervals and specific corrosion data are tabulated. Installations are cited in which brick joined with phenolic resin cement have been in continuous hot acid service for over ten years.

Testing Corrosion Resistance Properties of Paints

Goldberg, M. M. and Tomashov, N. D. Zavod. Lab., 1949, 15, 951–955.

The apparatus developed by the authors for the determination of the corrosion resistance of paint materials consists chiefly of two disc electrodes of 60 mm (2.4″) diameter each, one made of iron, the other of zinc, connected in one electric cell over a milli-ampere meter. The discs are painted with the paints, varnishes or lacquers tested, the electrolyte consisting of a 3 percent solution of calcium chloride. The determination of the corrosion resistance of the films tested is then based on the voltages observed and on the ampere/time curves obtained.

NEWS DIGEST

ALVIN C. GOETZ

Alvin C. Goetz Succumbs

Alvin C. Goetz, associated with The Eagle-Picher Company since 1923, and Manager of the Sales Service Department of the Pigment and Oxide Division of that Company, died recently at the Deaconess Hospital, Cincinnati, Ohio, after a brief illness. Stricken with a heart attack several weeks ago while on a business trip to Washington, soon after assuming a position as Chief of the Protective Coatings Section, National Production Authority, Mr. Goetz was brought to Cincinnati and seemed to be recovering when he suffered a fatal attack.

•

Du Pont Finishes Changes

Retirement of Clarence W. Clark, manager of the Chicago plant of the Du Pont Company's Finishes Division, on March 12 after 28 years of service was recently announced.

Simultaneously, these other changes were announced: H. Roy Ayres, assistant plant manager at Philadelphia, becomes manager of the Chicago plant. Louis S. Baker, assistant plant manager at Parlin, N. J., becomes assistant plant manager at Philadelphia. Norman I. Dress, assistant plant manager at Chicago, becomes assistant plant manager at Parlin. Carrol A. Doran, supervisor of the solvent area at Parlin, becomes assistant plant manager at Chicago.

•

Davison Chemical Names Paul Bachman Research Director

Dr. Paul Bachman has been named director of research and development of the Davison Chemical Corp. of Baltimore, Md. Dr. Bachman has been with the company since 1949, joining Davison as manager of development planning.

•

E. R. Mueller Named Coatings Research Head at Battelle

Ernest R. Mueller has been appointed supervisor of organic coatings research at Battelle Institute, Columbus, Ohio. Mr. Mueller has been with the Institute since 1945. In his new post he will be in charge of fundamental and applied research on paints, varnishes and lacquers.

•

Cadmium Use Now Permitted In Pigment and Inks

The NPA has amended its order (M-19) for the conservation of cadmium for defense and defense-supporting purposes to make the metal available for use in pigments, paints, inks and certain other essential civilian uses.

It also permits the use of cadmium in the making of pigments for luminescent and other paints and inks for purposes other than military.

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Southern Paint Club Elects 1951 Officers

The Southern Paint and Varnish Production Club at its recent annual meeting in Biloxi, Miss. have elected the following officers: President, A. E. Verbayla of Lenoir Wood Finishing Co.; president-elect, J. R. English of Leland Moore Paint & Oil Co.; vice-president, F. W. Frew of Decatur Chemical Co.; and secretary-treasurer, A. M. Holcomb of Carolina Paint and Varnish Works.

NEWS DIGEST

S. F. FREEMAN

S. F. Freeman Elected Vice-Pres. of Witco Chemical Co.

Stanley F. Freeman has been elected vice president and a director of Witco Chemical Company, and will be in charge of the company's Pacific Coast Division.

Mr. Freeman joined the company in 1949 and has been sales manager of the Los Angeles office since 1950. In World War II, he served in the United States Navy for four years as Lieutenant Commander. Mr. Freeman is a graduate of of the University of Massachusetts, class of 1936, and received his Master of Science from Massachusetts Institute of Technology in 1939.

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A. Stevens Elected Vice Pres. Of Elgin Manufacturing Co.

Election of A. R. Stevens as vice-president and a director of Elgin Manufacturing Co., has been announced by G. Radcliffe Stevens, president.

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E. G. Egan Heads Amsco Chemical Department

Edward G. Egan has been appointed to head Amsco's Chemical Department according to an announcement by Edward M. Toby, Jr., President of American Mineral Spirits Company. He will be located at the company's New York office. This marks further expansion of Amsco's activity in the chemical field which was inaugurated with the construction of their modern warehouse and terminal facilities at Carteret, New Jersay, in 1948. Edward G. Egan will be responsible for the sales of Amsco's complete line of chemicals.

Corrosion Talk to Be Featured at ASTM Meeting

Seven technical symposiums and many other technical papers on a wide range of subjects in the field of engineering materials are on the program of the 54th Annual Meeting of the American Society for Testing Materials at Chalfonte-Haddon Hall, Atlantic City, June 18 to 22, inclusive.

An important feature of the program also will be the Edgar Marburg Lecture to be given by Frank L. LaQue, international authority on corrision, and in charge of the Corrosion Engineering Section, International Nickel Co., who will discuss corrosion testing.

Matteson-Van Wey, Inc. Formed

Mr. M. R. Matteson and W. W. Van Wey have jointly announced the formation of Matteson-Van Wey Inc. with headquarters in Detroit. The new organization will represent the following firms:

Holland Color & Chemical Co.; Wheeling Steel Corp., Shipping Container Div.; Gillespie-Roger-Pyatt Co. Inc.; St. Joseph Lead Co., Zinc OCide Div.; Reynolds Metals Co., Aluminum Pigments; Durez Plastics & Chemicals, Inc., Resin Div.; C. E. Hoover; Godfrey L. Cabot Inc.; Vegetable Oil Products Co., Inc., Vopcolene Div., and S. L. Jones & Co.; and Advance Solvents & Chemical Corp.

TECHNICAL Bulletins

OILS CHART

Publication of a new, revised and enlarged Oils Chart has been announced by Archer-Daniels-Midland, Co., Box 839, Minneapolis 2, Minn.

In this new 24-page bulletin, more than 170 different materials are described and compared. These include a variety of linseed, soybean, and fish oils, fatty acids, ADM's broad line of specialty products, hydrogenated alcohols, glycerides, sperm oils, lecithin and other chemical products.

Detailed specifications and suggested uses are designed to make the new Oils Chart of special value to the chemist and formulator in paint, linoleum, soap, printing inks, lubricants, cosmetics and other chemical fields.

Other useful tables include an oils conversion chart, temperature conversion table, relative viscosity values, and bulking values for common pigments. It also offers data on thinners, solvents, plasticizers, driers and soaps.

TACHOMETERS

To describe how accurate speed recording is increasing production efficiency, product quality, and output in the metal-working, paper, textile, glass, ceramic, and other industries, Leeds & Northrup Company has just published a completely revised, 20-page edition of its speed recorder catalog—"Micromax and Speedomax Speed Recorders." It describes for the first time the application of Speedomax to speed recording, as well as new and improved tachometers for use with both Micromax and Speedomax. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Penna.

ONE COAT REPORT

This report covers two years of research on the Signal Corps' "One Coat Paint Project." Prepared by the New York University College of Engineering for the Army's Squier Signal Laboratory, this work covers such major factors as: basic research on the process of drying; drying paint films with light energy; electrographic method for testing permeability; panel paint tests; improvements in the development and evaluation of coatings; improvements in laboratory equipment; studies on adhesion; and a bibliography on the chemical reaction in the formation and drying of coating materials.

PB 101 680, "One Coat Paint Project" is available from the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C., at $8 in microfilm or $28.75 in photostat. Orders should be accompanied by remittance payable to the Librarian of Congress.

BUTYL TITANATE

Defense Research Laboratories have recently made reprints of the article "Butyl Titanate—Its Preparation, Polymerization and Uses in Paint" by G. Winter. These may be obtained free of charge by writing to the Chief Superintendent Defense Research Laboratories, Private Bag No. 4, Post Office, Ascot Vale., W. 2. Vic., Australia.

PLATY PIGMENTS

This report is concerned with the effect of varying quantities of platy material, wet ground mica, on the moisture resistance of paint films. Test program, results and evaluation are presented in detail. Wet Ground Mica Association, Inc., 420 Lexington Ave., New York 17, N. Y.

PLIOLITE

The Goodyear Tire & Rubber Company of Akron, Ohio has issued two new bulletins which describe some recent developments in connection with the use of "Pliolite S-5" in paints. Bulletin No. 521 is concerned with the formulation of "Pliolite S-5" in deep tone stucco or exterior masonary paints.

HIGH POLYMERS

Bibliography lists papers dealing in the fundamental physical and chemical investigations on high polymers. American and foreign papers are included. This bibliography offers a convenient reference for those engaged in investigation of the basic properties of polymers including such

phases as solution and gels, rubbers, thermodynamics of solutions, molecular weight, concentrated solutions and cross linking. Write to Superintendent of Documents, U. S. Government Printing Office, Washington 5, D. C. requesting NBS Circular 498. Remit 20 cents.

SUCRO OCTA ACETATE

Detailed information covering the physical and chemical properties, latest specifications and applications of sucrose octa acetate is presented in a bulletin prepared by the Niacet Chemicals Div., United States Vanadium Corp., unit of Union Carbide and Carbon Corp., 996 Niagara Bldg., Niagara Falls, N. Y. According to the manufacture sucrose octa acetate may be used in the formulation of nitrocellulose and cellulose acetate lacquers.

CHLOROWAX

Prepared especially for manufacturers of paints and enamels, an informative, 16-page technical service bulletin—*"Chlorowax 70 in Alkyd Enamel Systems"*—was issued recently by the Technical Service Division of the Research and Development Department, Diamond Alkali Company, Cleveland, Ohio, and is now available for general distribution.

Literature describes the use of Chlorowax 70, a chemically inert, non-toxic chlorinated paraffin resin, as a paint intermediate. Outlined in this connection are a number of typical systems for formulating air-dried and force-dried paint or enamel and which incorporate the material as a portion of the grinding base.

Modification of alkyd enamels with Chlorowax 70, the bulletin points out, results in the addition of flame retardance to the system, as well as improvement of chemical and salt spray resistance and film hardness while maintaining gloss. As a formulating intermediate, the material permits high vehicle solids at relatively thinner viscosity. It responds normally to driers and when properly formulated, has excellent compatibility.

Tabulation of the laboratory-evaluated specific properties provided by the 12 formulae used, in white, green and red vehicles, completes the presentation. Copies of this interesting, informative bulletin are available on letterhead request. Write to Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

SANTOCEL

Uses of Santocel C, a microscopically-divided silica aerogel, as a flatting agent are described in a booklet issued by the Merrimac Div. of the Monsanto Chemical Company, Everett, Mass.

Efficiency, oil absorption and the product's advantages in improving the resistance of clear films to weather, humidity, cold-check, and its uses in varnishes, alkyd flat coatings, and lacquers are described in detail in this booklet.

QUALITY CONTROL

A new ASTM Manual on Quality Control of Materials, sponsored by Committee E-11 on Quality Control of Materials, has been issued and takes the place of the widely used ASTM Manual on Presentation of Data.

The new Manual is organized in three parts. Part 1 essentially covers the presentation of data; Part 2 presents limits of uncertainty of an observed average; Part 3 explains the control chart method of analysis and methods for presentation of data. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

SURFACE COATINGS

(From page 26)

lecular weight or to copolymerization, is not disclosed by the manufacturer. These latices are available as an unplasticized emulsion ("BKS-90") and plasticized emulsion ("BKS-92"). "BKS-92" forms a tough, continuous film by evaporation of water; "BKS-90" does not form continuous film by itself; its main use being as a modifier to increase the film hardness of the plasticized emulsion. Ten to 20 parts of "BKS-90" to 100 parts of "BKS-92" will usually be satisfactory, but as much as 60 parts of "BKS-90" may be used. "BKS-90" may be used as a base to which varying amounts of plasticizers are added, usually 5 to 30 parts per hundred parts of emulsion. Some plasticizers, phthalates, may be added directly to the emulsion by means of a high-speed stirrer; others should be pre-emulsified, using ammonium oleate or other anionic emulsifying agents. Flexol 4GO (polyethylene glycol di-2 ethylhexoate) is recommended for flexible films of minimum tack, and DOP for soft, tacky films. The plasticized emulsion may be modified with additional plasticizers. Generally not more than 15 parts per 100 parts of emulsion is necessary if high flexibility is required. For most applications, unmodified "BKS-92" is sufficiently flexible. Non-volatile content is 30 to 33% for BKS-90 (unplasticized) and 37 to 40% for BKS-92, plasticized.

Clear coatings show a water-spotting tendency, which improves on aging and is entirely eliminated if coatings are force dried. Flat coatings of excellent transparency result from the use of 40 parts of diatomaceous silica per 100 parts of emulsion solids. This is used for washable wall paper where gloss is objectionable. For pigmented coatings, alkali-resistant pigments having a minimum of water-soluble components are recommended. Pigments treated to improve water dispersibility are best, but untreated pigments are satisfactory if a wetting agent is used during dispersion. One half—1% of aryl or alkyl sulfonic acids is recommended for this purpose.

There are two general methods for pigmenting polystyrene emulsions. In the first, pigments are pre-mixed with the emulsion and then ground; in the second, a pigment-water paste is prepared and this paste can then be added to the emulsion or the emulsion to the paste. Grinding by stone mill or roller mill after premixing the pigments in part of the emulsion in a pony mixer is a recommended practice for good pigmentation. Where optimum pigment dispersion is not required, high shear type mixer is not used. Pony mixers are used to prepare a heavy-bodied paste of pigment in water. This method of pigment dispersion is not as efficient as others mentioned but is satisfactory for flats. Pebble milling is not recommended because of excessive foaming. Commercially available pastes in water dispersible film formers and pulp colors are satisfactory, except modified-cellulose type film formers which destroy wash and scrub resistance. Thickening agents recommended to control consistency include ammonium alginate, alkaline polyacrylate, or Vinylite SYHM (Styrene-maleic anhydride copolymer) plus ammonia (¼ to 1% of any of these on emulsion weight). Pine oil (2 to 5%) acts as a thickener, improves flow and levelling, prevents foaming and improves continuity of films applied at low temperature. Waxes, about 5% in emulsion or pine oil solution improves abrasion resistance and moisture vapor impermeability. Application may be spray, dip, knife or roller coatings, and brushing. Due to its non-penetration and alkali resistance, this type of emulsion recommends itself for coating concrete, masonry, cement-asbestos shingles, fresh wall plaster, and rough textured cellulose fiber wall board; also for washable, flexible, non-blocking coatings for paper, textiles and leather, alone or with casein or alpha-protein.

Another important use of polystyrene emulsions is their addition to casein paints, materially improving durability and washability. Alkaline caseinate must be used, ammonium caseinate being recommended because of greater water resistance developed. Preservatives for the casein should be used. A marked increase in consistency on mixing casein dispersion and polystyrene emulsion, or even a seedy or lumpy appearance, is a temporary condition which will disappear upon continued mixing.

CALENDAR OF EVENTS

May 11–12. Spring Symposium of the Pacific Northwest Paint and Varnish Production Club, Multnomah Hotel, Portland, Ore.

May 24–25. Society of Plastics Industry Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va.

June 18–20. Thirty-fourth Annual Conference of the Chemical Institute of Canada, Winnepeg, Canada.

June 18–22. A. S. T. M. Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

Oct. 22–24. Thirteenth Annual Forum of the Packaging Institute, Hotel Commodore, New York City, N. Y.

Oct. 29–31. National Paint, Varnish and Lacquer Association Convention, Chalfonte-Haddon Hall, Atlantic City, N. J.

Nov. 1–3. Federation of Paint and Varnish Production Clubs, Chalfonte-Haddon Hall, Atlantic City, N. J. Paint Industries Show, Oct. 31–Nov. 3.

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WAXES

A complete collection of new technical data sheets describing the various waxes produced by the Concord Chemical. These data sheets cover such important factors as physicial and chemical properties, specifications, recommended formulation and uses. Write to the Concord Chemical Co., Moorestown, N. J., for your copy.

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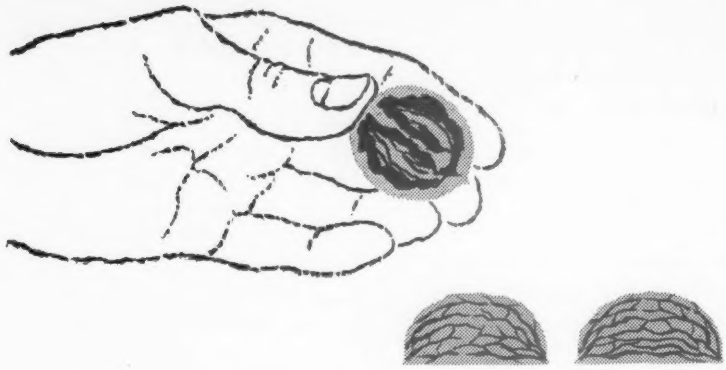

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